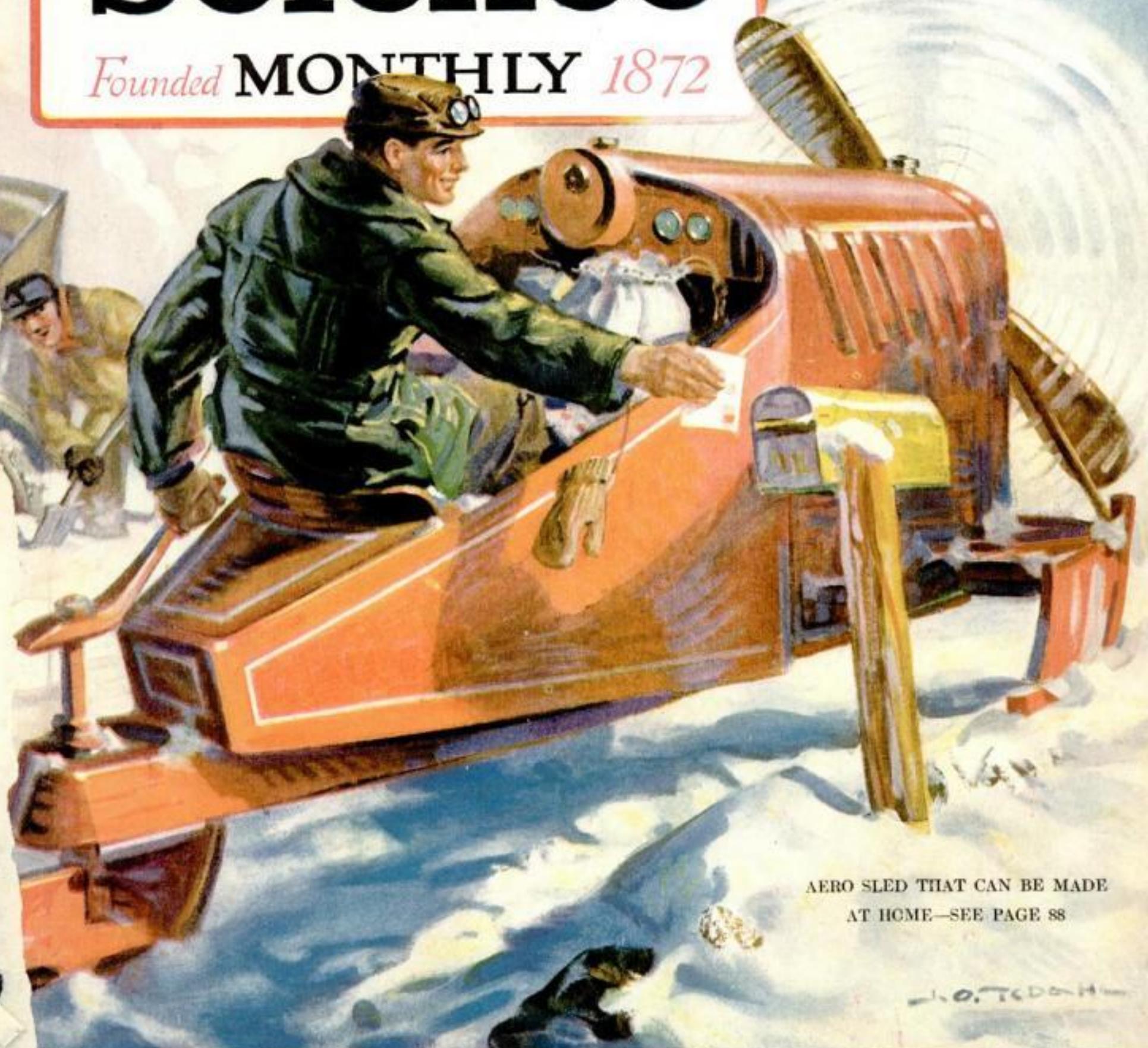


Popular Science

Founded MONTHLY *1872*



AERO SLED THAT CAN BE MADE
AT HOME—SEE PAGE 88

—H. O. T. DONAHUE—

Supendous Battle Pictures
of the "Next War"

\$240 in Prizes for Your Practical Ideas

EMBER

300 Pictures of New Inventions

25 CENTS

Copyrighted material

Yes, Sir!

I HAVE to make
special trips to
supply all the
people who want
Murads for Christmas
gifts.



Have You Learned to Typewrite Yet?

Universal typing is *here*. People are abandoning the slow, tiring task of long-hand writing. How long are you going to cling to it, in this world of advancement? Everybody dislikes to receive long-hand letters. And everyone shirks at correspondence when it has to be done the old-fashioned, tiring way. So join the progressive throng—get a typewriter NOW.

Free Trial

We ship the Oliver for five days' free trial. Let it sell itself. Or send it back.



\$49.50 or \$100? Which would you rather pay for a standard typewriter?

For 25 years all standard typewriters have been priced at \$100 or over and still are—except the Oliver.

It is the only standard typewriter selling at half. It is the only standard, \$100 typewriter being marketed direct from the factory.

Were it not for this simplified selling plan, the price of the Oliver would also be \$100 or over. For it is the same fine machine, the finest model we have ever built. Over 900,000 have been sold.

We simply sell the identical \$100 Oliver direct from the factory, and subtract all the extravagances of complicated selling. We have found that it is needless to maintain a high army of salesmen and agents. We have found it unnecessary to sustain a costly chain of branch offices in over 50 cities.

The \$50.50 you save is the sum that it would cost us to sell the Oliver the roundabout way. Plus a saving made because of the volume of business created by our plan.

Send No Money

We let the Oliver sell itself. We ship it to you for free trial. Then you can compare it with other standard typewriters at \$100 or over.

Some of the Famous Users:

New York Central Lines, Hart, Schaffner & Marx, U. S. Steel Corporation, N. Y. Edison Co., National Cloak & Suit Co., Morris & Co.—and hundreds of others.

14 Months To Pay

Pay for this Oliver while you use it. Only \$4 per month and you soon own it.

You become your own salesman. You are the sole judge. No anxious solicitor will urge you. In the privacy of your own office or home you can decide for or against the Oliver.

If you want to own it, send us \$49.50 cash. Or if you wish to pay for it in installments, send us \$3 after the trial period, then \$4 per month until \$55 is paid.

You can readily appreciate that it takes a super-typewriter to sell itself.

No test could be severer. Remember, there need be no fluent salesman to urge you.

If you decide against the Oliver, ship it back at our expense. We even refund the outgoing transportation charges, so that you do not risk one cent in the test.

Now we ask you, would you rather pay \$50.50 additional and not get a finer typewriter? Would you care to support a \$100 price for the Oliver, and get nothing tangible in return?

Or don't you agree that our new way of selling is logical? Doesn't it appeal to your common sense?

**SAVE
\$50.50**

How to Save

The coupon below brings you EITHER a Free Trial Oliver or Further Information. Check which you desire.

This is all you have to do to save the \$50.50. Without such a plan, you'd have to pay \$100 or over.

But this way you not only save—you get the finest typewriter that can be built by a leading maker. It comes fresh from the factory, our latest and best model, a 25-year development.

Check the coupon now and mail it in.

THE OLIVER Typewriter Company
1109 Oliver Typewriter Bldg., Chicago, Ill.

Ship me a new Oliver No. 9 Typewriter for five days' free inspection. If I keep it I will pay \$55 as follows: \$3 at the end of trial period and then at the rate of \$4 per month. The title to remain in you until fully paid for. If I make cash settlement at end of trial period I am to deduct ten per cent and remit to you \$49.50.

If I decide not to keep it, I will ship it back at your expense at the end of five days.

My shipping point is.....
 Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name.....

Street Address.....

City..... State.....

Occupation or Business.....

Now, why not obviate the Watchful Waiting for decay to manifest itself in out-of-doors woodwork by making everything of Cypress, "the Wood Eternal," in the first place?

Well, sure enough—why not go ahead and obviate? This kind of foresight is Some Obviator when it comes to Lumber Repair Bills.

It is possible that we might have a booklet you could use to advantage—we have 43 of them in the Cypress Pocket Library. Some have plan-sheets—big and practical and artistic—and exclusive—and they cost us something—you nothing. Volume One contains the list. Also what the government of the U. S. A. says about Cypress, "the Wood Eternal." Our address is below. What is yours? Is it all right to ask?

All-round Helps Department

Southern Cypress Mfrs' Ass'n.

1249 Poydras Building, New Orleans, Louisiana
1249 Graham Building, Jacksonville, Florida

Contents of the Home Workshop

A department for the man who works at home with tools

A Radio Receiver for Everybody.....	84
To Make a Pair of Balances.....	85
Attractive Ornaments from Clay.....	86
Moving Shadow Pictures.....	86
Dry Cells in the Country.....	88
Oil Filter for Farm or Shop.....	88
Speed Wrench of Simple Construction.....	88
Build Your Own Air-Driven Sled.....	90
Christmas-Tree Candle-Holders.....	91
A Woodbox Under the Stairs.....	91
New Prize Contest.....	92
Bench-Hook and End-Wood Planer.....	92
A Boring-Table for the Small Lathe.....	94
Piping a Garden Spring.....	94
To Make a Doll's House.....	96
Wood Puzzles that Will Interest.....	97
Making a Glue-Joint Invisible.....	97
Best Idea Contest.....	98
To Prevent Breaking a Small Drill.....	98
Housewives Will Find This Baker Useful.....	98
Improved Spur for Stump-Boring Auger.....	99
Can-Opener Made from Strap-Iron.....	99
Using the Discarded Gasoline Barrel.....	99
Useful Things to Do at Home.....	100
Shoe-Polishing Support.....	101
If Your Pipe Fails to Draw.....	101
Make This Disk-Grinder.....	102
A Fountain for the Poultry.....	102
Try a Rubber Hose on the Grease-Gun.....	103
Transforming a Kettle into a Glue-Pot.....	103
To Prevent Wood-Screws from Loosening.....	103
Weather Strip Will Adjust Itself.....	104
Indirect Light from Old Wash-Basin.....	104
Old Sink Forms Gas-Stove Foundation.....	105
Homemade Cook-Book Holder.....	105
Pistons Become Serviceable Bench Centers.....	106
Vulcanizing Molds Can Be Made at Home.....	106
Improvised Clamp for Home Use.....	106
Ornaments of Hammered Brass.....	107
Wide-Swinging Gate for Farmyard.....	108
Novel Spool and Twine Holders.....	108
Spinet Transformed into Bookcase and Desk.....	109
Ruler that Will Not Slip.....	109
Telephone Warns of Rain.....	110
One Method of Removing Obstinate Staple.....	110
Screw-Holder for Starting Screws.....	110
Hinged Tailboard with Eccentric Lock.....	112
Hallstand Built from Old Easel.....	112
Carburetor for the Coal-Range.....	112
Drawing May Cause Error in Machining.....	112
Reflected Light for Indoor Pictures.....	113
Winter Use for Electric Fan.....	113
Cleaning Under Surface of Boat Hull.....	114
Straightening Cotters to Bring Points Together.....	114
Stamp-Pads Made of Type Ribbons.....	114
Pulling Posts Rendered Easy by This Method.....	115
Preventing Standing Saw from Sliding to Ground.....	115
Attach a Hand Guard to the Wheelbarrow.....	116
Handy Nozzle on Hose for Filling Radiator.....	116
Use Old Books for Filing.....	116
Heat Room by Means of Gaslight.....	118
Reference-Book Pages Held with Tire-Tape.....	118
Providing Soft Nose for Peen Hammer.....	119
Making Cork-Handle for Fishing-Pole.....	119
Emergency Clothes-Line Pulley.....	119
How Leather Straps Can Be Made.....	120
How to Make Your Own Wire Terminals.....	120
Automatic Photo-Print Washer.....	121
Equip Tenon-Saw with Guard.....	121
Furniture Polish Renews Auto Lights.....	121
Cats Can Be Kept Off the Back Fence.....	122
Pipe-Pulling Tool Is Useful on the Farm.....	122
Old Skylight Serves as a Hotbed.....	123
Collapsible Stepladder for Home or Shop.....	123
Tip-Up for Fishing Through the Ice.....	124
Finger-Nail File Used as a Match-Scratcher.....	124
Carrying Storage Battery with a Chain.....	124
Drainpipes May Be Used as Porch Supports.....	125
Quick Repair of Broken Motorboat Muffler.....	125
Lawn-Mower Becomes a Countershaft.....	126
Pail and Tub as Improvised Air-Compressor.....	126
For Repairing Furniture Rungs and Legs.....	127
Sharpening Tool Will Concave Ice-Skate.....	127

What Is that Question You Couldn't Answer?

Let Popular Science Monthly answer it for you. Our Service Department will gladly supply information on problems of general science or on home-workshop perplexities. It is conducted for your benefit. Read page 53.

"The First Month I Earned \$1000"

-And he might have remained a farmhand

A \$50 a month job as a farmhand one day—out of a job entirely the next—and then a position that paid him \$1,000 the very first month! Such was the sky-rocket career of Charles Berry of Winterset, Iowa. And more remarkable still, it all came about as the result of a sunstroke!

How long he might otherwise have remained a farmhand, no one can say. Certainly, however, his work held little promise of better things for the future. Then one day as Berry followed his plow across the fields, under the scorching rays of a burning sun, he suddenly collapsed in his tracks. Sunstruck! He was forced to quit.

Subsequently he found employment in a variety store. His reward for long and tedious hours of clerking was \$18 a week.

Out of the Low Pay Rut

Not a very remarkable job—but it meant the turning point in Berry's life, for it brought the discovery of the way to big earnings. Berry had been noticing the Salesmen who came to call on the proprietor of the store. He noticed their prosperous appearance; they stopped at the best hotels, travelled on the fastest trains; and there was an independence and variety about their work that made their careers look like one long vacation compared to Berry's job.

One day Berry fell into conversation with one of the Salesmen.

"Yes," the latter said in answer to his question: "Salesmen do make big money. And here's the reason: the success of any business depends upon the amount of goods sold. The man who sells is producing profit for his firm. His services are in demand everywhere. He commands big pay wherever he goes. And there is no limit to what he can earn."

"But a man must have natural ability to become a Salesman."

"That's an old, out-of-date notion," the Salesman replied. "Salesmanship today is a science—it's just a matter of knowing how. Take myself for instance. I owe my success to the National Salesmen's Training Association. This is a wonderful organization of top-notch Salesmen and Sales Managers formed just for the purpose of fitting men for success in Salesmanship. It enables anyone to become a master of all the Secrets of Selling in his spare time at home.

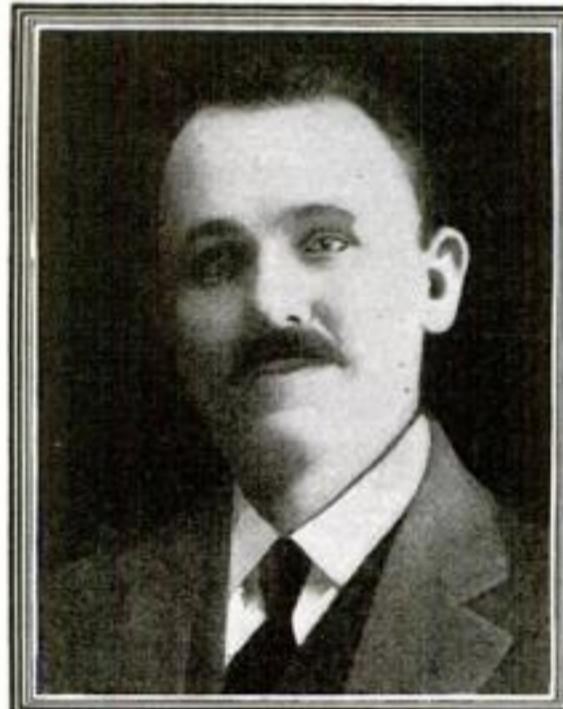
Other Amazing Jumps to Big Earnings

"Last week my earnings amounted to \$554.37; this week will go over \$400."—F. Wynn, 4103 Forty-Second St., Portland, Ore.

"My earnings during the past thirty days were more than \$1,000."—Warren Hartle, 4425 N. Roby St., Chicago, Ill.

"After six months of success in a position secured through you I am earning \$92 a week."—P. W. Broedel, 726 Benedict Ave., Woodhaven, N. Y.

"I had never earned more than \$60 a month. Last week I cleared \$306 and this week \$218."—Geo. W. Kearns, 107 Park Pl. Oklahoma City.



CHARLES L. BERRY

Why, it has made Master Salesmen out of men who had previously been clerks, bookkeepers, mechanics and so on. If I were you I'd write to the N. S. T. A. Just ask them to tell you about their system of Salesmanship Training and Free Employment Service."

Into the Big Money Class

Berry did as the Salesman suggested. The answer he received from the N. S. T. A. absolutely astounded him. It was nothing short of a revelation—it was the most amazing PROOF of the short cut to big earnings that he had ever seen.

Warren Hartle, of 4425 N. Robey Street, Chicago, for example, had worked for ten years in the railway mail service at pay ranging from \$900 to \$1,600 a year. Then through the N. S. T. A. he became a Master of the Secrets of Selling that brought him \$1,000 in thirty days.

George W. Kearns of Oklahoma City made \$524 in two weeks. Before this he had never earned more than \$60 a month. And C. W. Campbell of Greensburg, Pa., wrote, "My earnings for the past thirty days are \$1,526 and I won



second prize in March although I worked only two weeks during that month."

These are only a few of the cases of amazing jumps to big earnings. Berry was absolutely convinced and decided to accept the liberal offer of the N. S. T. A. to fit him for a position as a Master Salesman. In his spare time at home he learned the fundamental rules and principles of Salesmanship covering every branch of this fascinating field. Almost before he realized it he was ready to accept a position as Salesman with a big company to which the N. S. T. A. recommended him. The very first month he earned \$1,000. One month his earnings ran as high as \$2,140.

Startling Proof Sent Free

The same opportunity that brought Berry his amazing, quick success is now open to every reader of this magazine. You have only to write to the N. S. T. A. You will receive, without any cost or obligation, the remarkable Book on Salesmanship and startling Proof that you can quickly become a Master Salesman in your spare time at home. You will read the stories of hundreds of men who today are earning more money than they ever thought possible. What these men have done you too can do.

Surely you owe it to yourself to at least examine the evidence. It was worth \$1,000 a month to Charles Berry to write to the N. S. T. A. It may be worth that much or more to you. Just mail the coupon. There is no cost or obligation. Address

National Salesmen's Training Association

Dept. 15-W

Chicago, Ill.

National Salesmen's Training Association
Dept. 15-W., Chicago, Ill.

Please send me your Free Salesmanship Book and Free Proof you can make me a Master Salesman. Also tell me how the Free Employment Service of the N. S. T. A. will help me to a Selling position and send list of business lines with openings for Salesmen.

Name.....

Address.....

City..... State.....

DETROIT

The Auto Center Is the Logical Place To



Training for Head and Hand

LEARN AUTO AND TRACTOR BUSINESS



RADIATORS



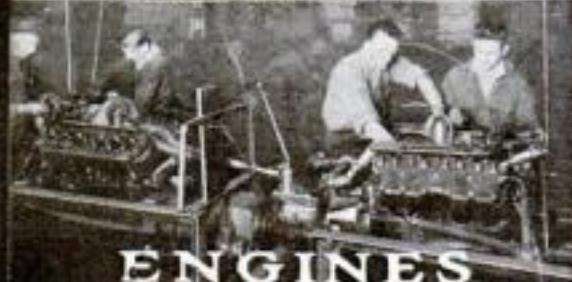
BATTERIES



TRACTORS



MACHINE SHOP



ENGINES

MICHIGAN STATE AUTOMOBILE SCHOOL

A. G. ZELLER, PRES. & GEN. MGR.

ENDORSED BY THE LEADING AUTOMOTIVE MANUFACTURERS
592 AUTO BLDG., 3729 WOODWARD AVE., DETROIT, MICHIGAN, U.S.A.

DETROIT
The Auto Center Is the Logical Place To
LEARN AUTO AND TRACTOR BUSINESS

The automobile business offers a certain future and exceptional opportunities to the ambitious man who wants to work intelligently to put himself ahead. Why not make your dream of success a reality? 9,500,000 automobiles, trucks and tractors in use in this country are but an indication of the immense opportunities in Service Work. Opportunities for properly trained men are unlimited. Competent men are in demand to take charge of garages.

Some of the Opportunities

A BETTER JOB: In repair shops everywhere incompetent men are working because no better can be had. A good man can get a job at a raise anywhere.

FARM MECHANIC: Modern farms must have engines, cars, trucks, tractors and trained men to run them and maintain them. Every farm needs a skilled mechanic.

ELECTRIC SERVICE: 75% of repair troubles are electrical. Not 10% of auto-mechanics are skilled in this branch. Mechanics who will take training in electrical work can double their earnings.

BUSINESS OF YOUR OWN: Start a garage, electric service station, tire repair shop, battery station, or welding shop. Or sell cars, trucks, tractors, farm lighting systems. Small capital needed, and men who know their business can get that. The opportunities are actually unlimited in every one of these lines.

M. S. A. S. Graduates Succeed

Practical training is the reason. The same opportunity is open to you when you are trained to take it, and you can be so trained in a few short weeks, by coming to the Michigan State Auto School, in Detroit the Auto Center.

Learn by Correct Methods Endorsed by Leaders of the Auto Industry

This school is recognized and endorsed by the automobile manufacturers and leading dealers,—the men who know how training should be given to make the most valuable men. They want men who have trained their heads as well as their hands,—the M. S. A. S. kind.

Not only were the M. S. A. S. courses outlined with the assistance of the leaders of the Auto industry, but manufacturers everywhere supply us with equipment and keep it up-to-date. They co-operate with us to the fullest extent, and employ our graduates.

What We Teach

Autos, trucks, tractors, stationary engines, farm lighting systems, tire repairing, welding and brazing, battery repairing, machine shop work. Actual practice on the best equipment, thorough and systematic instruction.

Study the pictures on this page and get our catalog showing over 100 views of M. S. A. S. training.

Money Back Guarantee

We guarantee to qualify you for a position as repair man, demonstrator, auto-electrician, garage man, automobile dealer, tractor mechanic and operator, chauffeur or farm lighting expert or refund your money.

Life membership with privilege of our service free at any time, is included with your enrollment here.

Learn by Factory Endorsed Methods

Packard Motor Car Co. says: "We have no hesitancy in recommending M. S. A. S. in every particular."

The International Harvester Co. says: "We will gladly cooperate with the M. S. A. S. through our 90 branches. Our free catalog contains many factory letters."

Thomas J. Doyle, Dodge Dealer, says: "I keenly appreciate the great work you are doing for the industry by turning out trained men who can intelligently handle the difficult phases of motor car trouble."

Cadillac Motor Car Co., Detroit, says: "We believe you have the best and most complete school in the country."

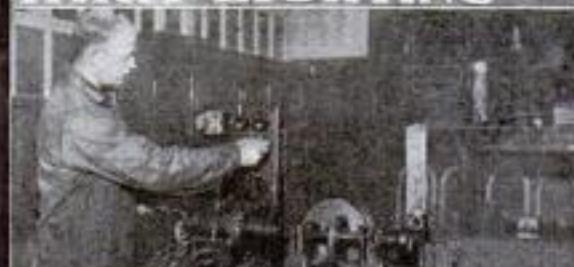
Send for 188 Page Catalog

This book tells in detail of the openings awaiting you in this great business, about M. S. A. S. training, methods and equipment. It includes letters from graduates in all parts of the world, telling what this training has enabled them to do, and dozens of letters from leaders in the auto and tractor industry endorsing our methods. There is no obligation in sending for this catalog. It will tell you more about the opportunities for trained men in the great automobile business and what the M. S. A. S. can do for you.

We will gladly reply to personal letters and answer questions fully. Write today.



FARM LIGHTING



ELECTRIC SERVICE



ELECTRIC SERVICE



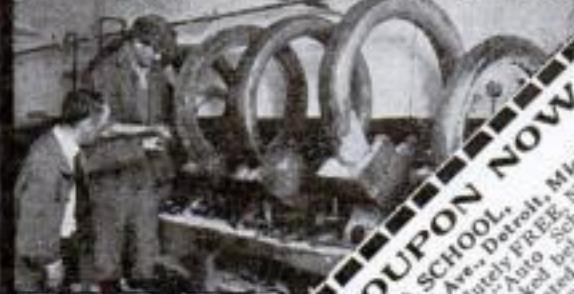
IGNITION



GARAGE



WELDING



TIRES

SEND THIS COUPON NOW

MICHIGAN STATE AUTO SCHOOL,
692 Auto Bldg., 3729 Woodward Ave., Detroit, Mich.
Name: _____
Age: _____
Gentlemen: Please send me absolutely free a copy of the illustrated catalog above.
(Mark each course you are interested in.)
____ Auto Repairing Course
____ Tractor Repairing Course
____ Machine Shop
____ Welding
____ Tire Repairing
____ Braising
Name: _____
Street: _____
City: _____
State: _____

See the New Ideas for Men Who Work at Home with Tools, Classified in the Home Workshop Index on Page 2

Popular Science Monthly

December, 1921 TABLE OF CONTENTS Vol. 99: No. 6

Special Features

How to Make an Aeroplane at Home Page 90

Harding's Portrait Sent by Wireless.....	21	Every-Day Wonders—Facts You Should Know.....	32
Explorers Search for Waste Places.....	24	First Suspension Bridge Since 1909.....	46
The Next War—Its Effect on Nations.....	26	Making Steel Direct from Ore.....	48
How Four Boys Made Fame and Fortune in Wireless..	29	Airplane to Carry Twelve-Inch Gun.....	61

And 164 Other Interesting Items

AERONAUTICS			
First Transatlantic Wireless News-Picture	21	A Plate-Glass Fairyland	37
The ZR2's Hangar	39	Giant Outdoor Reflector for the Moving.....	38
Keeps Airplane Engine from Freezing	44	No Telephone Headbands for Despatchers ..	38
Farmer's Airplane Rises from Barnyard	47	Bungalows Made from Steel Cars	38
Dirigible Directs Land Traffic	56	Graphite Sorting in Ceylon	40
Battleplane to Carry 12-Inch Gun	61	Fire-Truck Supplies Water Service	41
FOR THE FARMER			
Raising Figs Instead of Thistles	35	Bombs Reduce Ricters to Tears	41
Milk Aerator and Cooler	40	Inspecting High-Tension Telegraph Poles ..	42
Testing the Breath of Bananas	40	A New Way to Bob the Hair	42
Importing City Lighting for the Country ..	41	The Tower Bridge in Valve Fittings	42
Grading Wheat in Carload Lots	44	Caruso Candle Will Burn in 6921	45
Rain-Making Machine to Produce Storm ..	51	Plastometer Reads Contour of Head	46
Ventilated Apartments for Birds	56	Printing Our Own Postage Stamps	48
Wind Creates Natural Draft for Incinerator ..	57	Music Now Comes on the Movie Film	50
Some By Products of Corncobs	63	Grandstand from Ammunition Boxes	50
Seed Potatoes Cut by Machine	65	Enlarged Phonograph as Vocal Sign-Post	50
Homemade Sterilizer for Dairymen	68	Here Are Two Drums in One	50
Shoes for the Equine Beg Trotter	72	Scissors Create Scenery for Movies	51
Build a Homemade Water-Pump	82	Portable Typewriter for the Blind	51
Let Your Ford Help in Farm Work	82	What Do You Want to Know?	53
HOUSEKEEPING MADE EASY			
Holds Lamp Globes Safely	38	Wooden Tone-Arm for Phonographs	54
Electric Iron Forms Stove	40	A Country Estate on a Factory Roof	54
Open Fires Without Smoke or Dirt	54	Rotary Photo-Print Trimmer	54
Baby's Bath and the Latest Improvements ..	57	Primitive Canoe of Inflated Skins	55
Electricity Heats Water Passing Faucet ..	67	Power House Starts When Light Goes On ..	56
INDUSTRIAL PROGRESS			
Machine Ties Parcels like Grain-Binder ..	22	House-Moving in the Philippines	56
Last Explorers Seeking Wealth for Mankind ..	24	Movies Carry Their Own Power Plant	57
Railroads Use Buses to Improve Service ..	28	Street Stations for First Aid	57
Your Chances for Success in Radio ..	29	Be Measured for New Set of False Teeth ..	59
Conveyor Handles 100 Tons an Hour ..	35	Tropical Lineman's Hard Job	59
Boxes Fall 30 Feet Unhurt ..	35	Submarine Mine-Sweeper Enters the Movies ..	59
Print 1500 Photographs an Hour ..	37	Identifying Criminals by Their Pores	60
For Cutting Brass Rods	39	Another Scale Pest	63
Portable Lamp Guard	39	Motion-Pictures without Darkening Theater ..	64
Endless Elevator Loads Truck Quickly ..	40	Cow-Punchers Use Modern Mess-Wagon ..	64
Machine Measures Leather Area ..	41	Safety-Pin for Milk-Cans	64
Horizontal Forge Press Economizes Space ..	42	Flashlight with 300-Foot Range	64
Oil Tank Was Moved Nine Miles ..	45	Making Heat Instantly	65
Hydrochloric Acid Removes Boiler Scale ..	45	To Measure and Record Rainfall	66
Suspension Bridge at Kingston	46	Flood Lights Illuminate Skyscraper	66
Million Tons of Coal from River Beds ..	47	Saidy Date Goes to Quarantine	66
Making Steel Direct from Ore	48	Sword-Swallowing Made Possible	66
Earth-Borer Plants Dynamite	51	Clock Whittled from Bamboo	67
Extracting Oil from Apricot Kernels ..	51	Pockets in Her Hat	67
Diver Can Now Light Torch Under Water ..	52	Combination Chair and Umbrella for Artists ..	67
Good Lumber from Dead Trees	52	Spectroscope Detects Bloodstains	68
Rapid Interest Indicator for Banks	54	Government Preserves Indian Folk-Songs ..	69
Contractor's Truck Carrries Double Hoppers ..	54	Delivering Beer with a Hose	69
Hand-Power Drill for Prospectors ..	55	Man-Propelled Trolley	69
Fast-Grinding Compound for Bearings ..	56	No Contest for This White House	69
Separates Liquids from Soil	57	Moving Roadway for Japan	69
Centrifugal Force	58	Film-Projector and Screen in Same Cabinet ..	70
It Measures Wire of Any Size	60	Rolling Desk for Crippled Children	70
Blasting Fuses Cut to Safe Measure	66	Renews Blotting Surface	71
Handle-Bar and Package-Carrier	66	Purdue Has World's Largest Bass Drum ..	71
Machine Makes Five Operations	67	This Extinguisher Uses no Liquid	72
Writing a Message by Phone	68		
Building-Block Made on Continuous Molder ..	72		
MISCELLANY			
Civilization Must Abolish War	26	Copyright, 1921 by the Modern Publishing Company	
Every-Day Wonders	32	POPULAR SCIENCE MONTHLY is issued monthly. Yearly subscription in the United States, \$3.00. Canada, \$3.50. Foreign, \$4.00. Single copy, 25 cents.	
Hand-Loom Produces Big Cravat Output ..	35	Advertising rates on application. Entered as second-class matter Dec. 28, 1915, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada.	
The Canyons of Lower New York	35	The contents of this magazine are copyrighted and must not be reprinted without permission. H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.	
Adding Perspective to Motion-Picture ..	36	Modern Publishing Company 225 West Thirty-ninth St. New York City	
Elevators that Run on a Curve	36		
Polarized Light Reveals Original Picture ..	37		
RAILWAYS			
Completely Automatic Car-Coupler ..	42	Davits Lowers Lifeboats Quickly	52
Locomotive Coal Pusher Saves Labor ..	51	Million Dollars Lost if This Lamp Goes Out ..	55
Trolley-Car Gives Local Service from Trains ..	52	Bulges as Protection from Torpedoes	55
Railway Cars Unload Automatically ..	64	Mississippi's Shallow Draft Towboat	69
Giving the Engineer His Orders ..	65	Pontoons to Replace Ferries	71
SHIPS AND SHIPBUILDING			
Davits Lowers Lifeboats Quickly	52		
Million Dollars Lost if This Lamp Goes Out ..	55		
Bulges as Protection from Torpedoes	55		
Mississippi's Shallow Draft Towboat	69		
Pontoons to Replace Ferries	71		
SPORTS AND PASTIMES			
Made to Order Collisions for Amusement ..	34		
Steel Ukuleles withstand Hard Usage ..	38		
Bumps Help Drive This Bicycle ..	38		
Roller Coaster Built by Children ..	44		
Remote Control of Clay Pigeon Traps ..	63		
Can You Get These Eye-Testers? ..	65		
Bicycle Steers from the Rear ..	73		

\$240 in Prizes Offered in This Issue—See pages 74, 82, 92, and 98

QUICK-ACTION ADVERTISING

HERE READERS AND ADVERTISERS MEET TO TRANSACT BUSINESS

Rate 25 Cents a Word. Advertisements intended for the February issue should be received by December 1st

AUTOMOBILES AND ACCESSORIES

AUTOMOBILE Parts for all cars—50% off manufacturers' list price. Pistons, connecting rods, cam shafts, crank shafts, cylinders, axles and gears. Our new catalogue and Used Parts Bulletin now ready. Write for it to-day. Service and satisfaction guaranteed. Auto Parts Company, 4108 Olive Street, St. Louis, Missouri.

TOWLINES sixteen feet long with hooks. Small enough for tool box. Replaced if broken within year. \$2.50 delivered. Agents price \$15.00 dozen. Sample \$1.50. Order sample to-day. Will buy back any you don't sell. The Superior Manufacturing Co., Penn Bldg., Cleveland, Ohio.

PATENTS—Write for Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature. Highest reference. Reasonable terms. Victor J. Evans & Company, 189 Ninth, Washington, D. C.

AUTOMOBILE Owners, Garagemen, Mechanics, Repairmen, send for free copy of our current issue. It contains helpful, instructive information on overhauling, ignition troubles, wiring, carburetors, storage batteries, etc. Over 120 pages illustrated. Send for free copy to-day. Automobile Digest, 523 Butler Bldg., Cincinnati.

SLICKER OIL, saves 25 to 50% gasoline. Cleans carbon from engine. Harmless. Fully guaranteed, money refunded if failing. Sample to treat 125 gallons gasoline, \$1.00 C. O. D. Slicker Oil Co., Gateway Station, Kansas City, Missouri.

STORAGE Battery Charging earns unusual profits using HB Chargers. \$20 starts. Balance payments Box 1, Hobartson's, Troy, Ohio.

AUTOISTS: This preparation seals radiator leaks quickly. No soldering; doesn't clog radiator, 65 cents postpaid. Radiator Repair Shop, Dept. M, 799 Drew St., Appleton, Wisconsin.

AUTOMOBILIST Attention: Spark Plug Tester tells condition of your spark, most handy article. 25¢ post paid. Radio Service & Manufacturing Co., Lynbrook, Long Island.

PISTON Ring perfection reached, send for free evidence booklets, "It's What the User Says that Counts," that's making the demand for Zeinicker Ever Tites the ring that saves fuel and oil and increases efficiency, stops oil pumping, and saves reboiling of cylinders. Made in all sizes up to 100 inches for boats, locomotives, engines, pumps, compressors, airplanes, etc. Will send on trial to anyone commercially rated. Ever Tite Piston Ring Div., St. Louis.

FORD ACCESSORIES

WIZARD battery charger for Ford cars, charges 6-volt battery from Ford magneto. Attaches to Ford in few minutes. Guaranteed to work perfect. Hundreds in use. No more oil lamps, electrify your Ford. Price \$4.95, postage prepaid. Send money order. Agents wanted. Write for circular. Wizard Mfg. Company, 206 Jefferson St., Portland, Oregon.

GASIFIER saves gasoline, helps starting, prevents carbon; applied ten minutes, no changes. Special price Fords \$1. Detroit Gasifier Co., 743 Book Building, Detroit.

SPEEDSTER Fans. See "Red-i-Kut" ad, page 125.

ELECTRICAL

BURGLAR ALARMS: Complete electric systems ready to install. Write for circular. W. B. Kuhn, 1806 Lafayette, St. Louis, Missouri.

WANTED

MANUFACTURER of wire specialties and stampings wished to add additional articles to their line. Have you a product or a patent? Address Atlas Manufacturing Co., New Haven, Connecticut.

SPOT Cash for gold and valuables; returned if dissatisfied. Assaying for prospectors by graduate metallurgists. Central Refiners, 503 N. Prospect, Champaign, Illinois.

WANTED—Representatives in every Factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

UNUSUAL opportunity to earn large commissions in your town. Zeinicker, 1600 Kingsland Ave., St. Louis.

DUPLICATING DEVICES

"**MODERN**" Duplicators. Business Getters. \$2.25 up. 50 copies from pen, pencil, typewriter. No glue or gelatine. 40,000 in use. Free trial. Need one? Booklet free. J. V. Durkin-Keeves Co., Pittsburgh, Pennsylvania.

FORMULAS

FREE—Formula Catalog. Laboratories, Boylston Building, Chicago.

FIVE formulas, \$1.00: Silver Polish, Starch Enamel, Formula for Gray Hair, Superior Baking Powder, Sewing Machine Oil, Toothache Drops. Albert Wilkinson, 81 Erie Avenue, Brantford, Ontario, Canada.

BEST SHINE Auto, Furniture, Polish. Formula \$1.00. B.L. Collins, 4018 Ross, Dallas, Texas.

3000 FORMULAS—400 pages, \$1.00. Catalogue free. Elwood Book Shop, 7021 D. So., Winchester, Chicago.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

MANUFACTURING

LET us be your factory! Write to-day. Logan Machine Company, 222 South Clinton Street, Chicago, Illinois.

WE manufacture anything, develop and build special machinery. Get our booklet, it's valuable to you. R. G. Clyne Engineering Co., St. Louis, Missouri.

LABORATORY AND CHEMICAL SERVICE

CHEMICALS, glassware—complete supplies for the chemical laboratory. Catalogue 5 cents. National Scientific Supply Co., 241 Pennsylvania Avenue, Washington, D. C.

CHEMIST will test raw and finished products; formulas; solve industrial problems, and give testimony. J. Gaub, Lexington, Kentucky.

YOUR chemical or electrical problem solved for Five Dollars. Write me. W. Stedman Richards, Consulting Chemist, 220 Washington St., Boston, Massachusetts.

Read This One!

Popular Science Monthly,
New York City.

Gentlemen:

As you know, I have been running an advertisement in Popular Science Monthly for nearly nine years, only missing when I was "doing my bit," and I must say that the amount invested is small considering the wonderful ORDERS—not merely replies—I have been getting.

I also notice that my key shows MORE REPLIES on "stationery" from your publication than any others, proving that the better type of business man reads the Classified Section.

You can count on my ad "t. f."

Very truly yours,
IRVIN DANIEL WOLF,
Printing.

This letter is but one of many which come in—VOLUNTARILY—from satisfied and successful advertisers. If YOU are interested in direct, profitable and continuous results at low cost, why not come along with us in the next issue? For further information as to rates, closing date, circulation, etc., address:

Classified Advertising Manager,
Popular Science Monthly,
225 West 39th Street,
New York City.

MAILING LISTS

MARRIAGES \$5.00 per thousand. Other lists. Miller, Box 41, Berwick, Pennsylvania.

AMERICAN MADE TOYS

MANUFACTURERS wanted for large production and homeworkers on smaller scale for Metal Toys and Novelties, Toy Soldiers, Cannons, Cowboys, Indians, Buffalo Bills, Wild Animals, Whistles, Bird-Whistles, Race Horses, Prize-Fighters, Wagtail Pups, Put and Take Tops and hundreds of other articles. Hundreds and thousands made complete per hour. No experience or other tools needed. Bronze casting forms, complete outfit from \$5.00 up. We buy these goods all year, paying fixed prices. Contract orders placed with manufacturers. Exceptional high prices paid for painted goods. An enormous business for this year offers industrious men an excellent opportunity to enter this field. Write us only if you mean real business. Catalog and information free. Metal Toy Manufacturing Co., 1696 Boston Road, New York.

MOTORS, ENGINES, MACHINERY

ELECTRIC Motors, 50 heavy duty 34 H. P. motors. General Electric and other standard makes. 110 volt, 60 cycle, single phase. Brand new, never unpacked. Guaranteed perfect. \$18.00 and \$20.00. Pennsylvania Motor Exchange, Lancaster, Pennsylvania.

SMALL Motors and Generators, 14 H. P., \$18.50; 16 H. P., \$28.50; 1 H. P., \$68.50. 6 V. charging generators, \$10.50 each. All sizes both motors and generators up to 5 H. P. in stock at all times. Bargain prices. Motor Sales Dept. 14, West End, Pittsburgh, Pennsylvania.

GUARANTEED Motors, Polyphase, 2HP \$75. Easy payments. Other sizes also. Write us. Box 2, Hobart, Troy, Ohio.

AVIATION

HEATH propellers represent the most efficient method of aerial drive. Each propeller individually designed for the particular work to be done, as laid out by America's oldest Aeronautical Engineer. Propeller catalog 4c. Heath Airplane Co., Chicago.

PROPELLERS for air propulsion. 5 ft. diameter \$12. Other sizes in proportion. Hub mountings, bearings, sprockets and countershafts complete. Full scale blue prints for motorcycle-driven snow and ice sleds, 75c. Ford type, \$1. Crawford Motor and Aeroplane Mfr., 142 South Rampart Street, New Orleans, Louisiana.

FOR November we offer the greatest bargains in the history of aviation. Dope \$1.70, turnbuckles all sizes 25c, aero cloth 39c yard, tachometers \$10, shock absorber 10c ft., Curtiss motors \$275, Gnome motors \$175, new propellers \$18, clevis pins 2c, wheel covers \$1.25, steel tubing 5c. Many wonderful bargains in November sale sheet. Heath Airplane Co., Chicago.

INVENTORS desiring information write for our Free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch of invention for our opinion of its patentable nature. Highest references. Prompt service. Reasonable terms. Victor J. Evans & Company, 151 Ninth, Washington, D. C.

BOYS build a three foot model aeroplane. Write for circular. Full size drawing. Aero Shop, 3050 Hurbut Ave., Detroit, Michigan.

LEARN to fly with America's oldest aircraft company. Six hours flying worked in with three months' shop training at \$190.00, makes our course the most complete ever offered, and an opportunity long waited for. Enroll at once. Heath Airplane Co., Chicago.

MODEL AND MODEL SUPPLIES

WE make working models for inventors and do experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

GET our booklet before placing order for models or anything you need. Our work the best, our prices right, our dealings square. R. G. Clyne Engineering Co., St. Louis, Missouri.

MODELS and Experimental Work of every description. Lamson Model and Experimental Works, 625 West Jackson Boulevard, Chicago.

MODEL aeroplanes that fly. Buy your complete outfit, scale drawings, fittings, compressed air motors and all best model aeroplane supplies from the Wading River Manufacturing Company. Established 1909. Our new fifty-two page catalog illustrates twenty-four latest models and designs. Send 10c for your copy. Wading River Manufacturing Company, 672B Broadway, Brooklyn, New York.

FOR THE HOME

GRANDFATHER clock works, \$5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Pennsylvania.

FIREARMS

MAUSER .25 cal. automatic pistols, \$11.75; .32 cal. \$12.75; f. o. b. New York; factory new; no C. O. D. Ben Sloan, 88-C Chambers Street, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

EFFICIENCY CHARTS

EFFICIENCY CHART. One side instantaneous stock ordering chart; other side, spark method of testing steel. Price, One Dollar, cash. A. E. Wrigley, 225 90th Street, Brooklyn, New York.

LETTER SPECIALISTS

FRANCIS writes the Best Sales Letters in the World. Floyd Delos Francis, Box 604, Atlantic City, New Jersey.

LETTERS applying for a position of any nature expertly written. \$1.00. Floyd V. Studer, Canadian, Texas.

SALES Letters. Multigraphing. Circular Mailing. Miller, Box 41, Berwick, Pennsylvania.

Copyright material

My New Way in Selling

How I Learned the One Great Secret of Salesmanship in Twelve Hours

"**Y**OUNG man, my advice is, to get into the selling end of the game!"

"But—"

"No buts about it, if you want to go ahead—sell. It is salesmen we want today—Salesmen. If you can sell things you will never have to worry about securing a position, or demanding a good salary."

"But, Mr. Cranshaw, I have had no experience — know nothing about it, why—"

"Then learn, sir—you've asked my advice and help, and there it is."

Deeply puzzled, I left his office. Like so many other young fellows looking for their first job, I had no very definite aim. I didn't mind hard work or small pay, as long as I felt that the future held some opportunity. I had called upon my father's old friend, Mr. Cranshaw, to help me decide what calling he thought promised the most. The above conversation was the result.

Mr. Cranshaw is an experienced business man and I respected his opinions. With his aid I found a job—and a fairly good one as jobs go—with a large farm-machine manufacturing company.

As soon as I learned something about my product I went out on the road. The optimism of youth was with me. I had a tremendous amount of self-confidence. My product was a good one.

But I ran into a snag when I came in contact with the hard-headed men who till the soil.

They were of all types, keen, and shrewd progressive men, who wanted to see an actual gain—return for every penny spent; old-fashioned men who didn't take to new-fangled methods; big business men who ran immense farms as a side issue. Every one presented a knotty problem. It seemed to me in my early days, that each man had to be "sold" in a different way. I kept a separate "method of attack" for each individual.

But, I was not a success. I made few sales. Every now and then, I put over a fairly big order, but I was not a consistent seller. The firm was not satisfied and they said so. I was costing them more than my work was bringing in. In a very frank talk one morning, they told me that if something didn't happen at once, I would be called in from the road.

Well, needless to say, I was discouraged. I thought things over. The success of my brother salesmen and competitors puzzled me. I observed them closely and tried to learn what it was that brought them their big sales. I noticed, to my surprise, that the men whose totals were the largest were the ones who seemed to work the least. But I could find no one trick that any of them possessed which I had not tried.

One day I met a hardware salesman in

the smoking room of a train. We talked about the usual things for a while then we branched into selling methods. In the course of his conversation he told me how,



"In the last nine weeks my sales have topped the list."

after many years of mediocre success, he finally learned the one great secret of selling and what that secret is. It was simple as A. B. C.

It almost bowled me over. The simplicity and practicality of this great basic rule of success dazzled me. My guardian-angel must have been watching over when I met that salesman.

With impatient eagerness I started to put into practice my new-found knowledge. The startling suddenness of the results was almost uncanny. After my next turn on the road the senior member of the firm personally congratulated me. My sales on that one trip were larger than the total of my three previous efforts. In four short months I became the best salesman on the firm's roster. I was leading even the oldtimers. And from that time to this I have never once relinquished the lead.

Mr. Cranshaw's promise had come true—"Get into the selling game, if you want to go ahead," he had said—and I had.

But before I had found the all-comprising fundamental secret of salesmanship, I had been as near a failure as a man can be. The rapidity of my sensational rise seems almost unbelievable—even to myself.

Don't misunderstand me, I am not trying to pat myself on the back. I am not an unusual man in any way and do not claim to be. What I am driving at is this: If I, a young fellow who almost missed my chance, could, in the short space of four months, become a top-notch salesman, merely by the mastery of *this one principle*,—others can do the same. And I must add my opinion to Mr. Cranshaw's, the selling game does hold the greatest promise of all for the future success.

This thing which so quickly placed me in my present highly-paid position of master-salesman was a knowledge of the One Great Secret in Selling, and its 100 Devices as told in Arthur Newcomb's astonishing 7-lessons course in Super-Salesmanship. This course, I firmly believe is the nearest existing thing to a Royal Road to Success in Selling.

It is not, like so many other salesmanship courses, a theoretical treatise. It is old-fashioned common-sense brass-tacks. Like all other sciences, selling has for its foundation a certain bed-rock law. Ignorance of this is the reason so many salesmen fail.

Mr. Newcomb takes this law, shows it to you, explains it, and then shows you how to use it. It is your weapon. And it is worth more than all the tricks and stunts, and theories of selling put together.

Mr. Newcomb does not teach or preach. From his years of experience as salesman, sales-manager and student of selling-science he had condensed into this remarkable book, the one great selling secret—and its one hundred simple devices which all successful salesmen must have. He gives you this secret—that is all there is to it. No matter what you are selling the rule applies. Mr. Newcomb says, "This is the way to do it. Now go ahead." And it works. It always has worked. It has been tested and approved by every man who ever sold anything. Consciously or unconsciously *every sale that has ever been made, was made by the application of this one tremendous truth*.

But do not take anybody's word for it. You can be the judge yourself. It will not cost you one penny. Merely mail the coupon or write a letter, and the complete course will be sent, all charges prepaid, at once, so that you may take advantage of the special price and save \$2. If you are not entirely satisfied, send it back any time within five days after you receive it and you will owe nothing.

On the other hand, if you are as pleased as are the thousands of other men and women who have used the course, send only \$3 in full payment. You take no risk and you have everything to gain, so mail the coupon now before this remarkable offer is withdrawn. Independent Corporation, Dept. S-7712, 319 Sixth Avenue, New York City.

(FREE EXAMINATION COUPON)

400,000

people have paid \$5 or \$7 for one of our Self-Improvement Courses—and remember no one was asked to pay until he had five days to examine the course in his own home.

Until the Independent Corporation published the "Roth Memory Course," "Paragon Shorthand," "Mastery of Speech," "Drawing Art and Cartooning," "Reading Character at Sight," "How to Write Stories," "Super-Salesmanship," and other personal development courses, where could anyone buy similar courses for less than \$15 to \$75?

Because we want to add two hundred thousand more names to our list of satisfied customers at an early date, we are making a

SPECIAL PRICE, \$3 (Regular Price \$5)

Others sell from \$15 to \$75

Act quickly as this special opportunity may be open for only a short time. Many purchasers have written letters similar to Robert P. Downs, of Detroit, Mich., who recently wrote:

"I can't see how you ask so little, while others with far inferior courses get from \$20 to \$80 for theirs."

Dept. S-7712, 319 Sixth Avenue, New York

Gentlemen:—Please mail me the Course "Super-Salesmanship" for 5 days' free trial. If I decide to keep it I will remit \$3. the Special Price. Otherwise I will return it to you. It is understood that this coupon puts me under no obligation whatsoever.

Name.....

Address.....

Pop. Sc. 12-21

Copyrighted material



**He Was a
Machinist
Now He Is a
Mechanical Engineer
He Used to Make \$26 a Week
He Now Gets
\$7,500 a Year**

John Guest worked in a machine shop with a score or so of others. He could read and write and do simple arithmetic—that was all. Several of the others had received considerably more schooling than he.

His advancement began when he took up a course in Mechanical Drafting in his spare time. Once he had learned drafting, he forged straight ahead. He was made foreman for the company, then superintendent, then, because by this time spare time study had qualified him for the place, he became mechanical engineer for a great manufacturing concern.

Most of "the others" are still in the shop, or in other similar shops, or looking for jobs in shops. Those who have work earn a little more now, it is true, but their dollars buy far less. Every one had the same chance as John, but—

You have the same chance, too. The I. C. U. Mechanical Drafting Course is YOUR opportunity to qualify for a position like John's. In your own home, in your spare time, without losing an hour from your work, you can make yourself a practical Mechanical Draftsman.

Back of the I. C. U. courses stands T. J. Foster, founder of correspondence instruction, the first man in the world to demonstrate that Mechanical Drawing could be taught successfully by mail. Associated with Mr. Foster as Dean of the Faculty of the I. C. U., is Harry S. Bitting, President of the Williamson Trade School, the acknowledged leader among American vocational schools.

I. C. U. courses are sold on the

Pay as You Study

plan. The student is greatly advantaged because, whether he enrolls for cash or on the installment plan, he pays for only a part of his course at a time as he proceeds with his studies.

Take the first step toward a position and salary like John Guest's. Use the coupon. No obligation.

Industrial Correspondence University, Inc.
Dept. C, 1504 Locust St., Philadelphia, Pa.

Please send me full information about the course before which I have marked X and about your "Pay as You Study" plan. In asking for information, I assume no obligation.

Mechanical Drafting
Architectural Drafting
Complete Blue-Print Reading
Blue-Print Reading for Machinists and Metal Artisans
Blue-Print Reading for Carpenters and Building Tradesmen
Blue-Print Reading for Structural Ironworkers
Blue-Print Reading Pattern Makers and Cabinet Makers
Blue-Print Reading for Blacksmiths
Foremen's Course
Course in Employment Management and Personnel Activities

Name.....

Street & No.

City or Town. State.

Occupation. Age.

FOR BOYS

PLAY Mouth-organ. Complete, easy instructor, 25c. Elsea, Publisher, Bowling Green, Ohio.

STAMPING NAMES

MAKE \$19.00 Hundred Stamping Names on Key checks. Send 25c for sample and instruction. PS Keytag Company, Cohoes, New York.

CIGARS, CIGARETTES, TOBACCO

BUY your cigars direct. Fifty La Columnas Prepaid \$1.75. Agents wanted. Havana Smokehouse, Homeland, Georgia.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

MISCELLANEOUS

HOW to Build Beautiful Homes at Small Cost. Read my book on the Twentieth Century Building Materials. Price One Dollar. Circulars free. Peter de Linde, Zion, Illinois.

FOR your lawn use hardwood ashes. Sixteen dollars ton. George Stevens, Peterborough, Ontario.

MFRS. lead soldiers; save time. Painting made easy. Make device yourself. Instructions postpaid, \$1.00. Lock Box 146, Aurora, Illinois.

LUMINOUS Paint, Bottle 20c, Laboratories J, Box 316, Portland, Oregon.

TELEGRAPHY

TELEGRAPHY (both Morse and Wireless) and Railway Accounting taught quickly. Big salaries. Great opportunities. Oldest and largest school; established 46 years. All expenses low—can earn large part. Catalog free. Dodge's Institute, K Street, Valparaiso, Indiana.

STAMMERING

STAMMERERS—You can be permanently cured by my course of private individual lessons. Interesting booklet free. Samuel E. Robbins, 246 Huntington Avenue, Boston.

ST-TUT-T-T-TERING and Stammering cured at home. Instructive booklet free. Walter McDonnell, 59 Potomac Bank Building, Washington, D. C.

ADVERTISING

ONE Inch Advertisement in 100 country town newspapers, \$12.00. Ad-Guide free. Concordia Magazine, 2DW York, Pennsylvania.

\$1.00 day makes classified advertising pay big. Get proposition. Climax Advertising Agency, Desk G, Clinton, Iowa.

FLYER! 28 words in 250 weeklies, \$10. Central Agency, Champaign, Illinois.

ADVERTISE in 24 Metropolitan Dailies, 25 words \$15. Helpful Guide listing 1000 publications, 4c stamps. Wade, Baltimore Bldg., Chicago.

HAVE your letters, folders, booklets, written by original forceful writer who digs for business—That's me. Johnson, 2043 Howe St., Chicago.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

TYPEWRITERS AND SUPPLIES

ALL makes, \$15.00 up; fifteen days' free trial. Catalogue mailed on request. Henry Typewriter Company, 217 West 125th Street, New York City.

TYPEWRITERS—All makes. Factory rebuilt by "Famous Young Process." As good, look like, wear like, guaranteed like, new. Our big business permits lowest cash prices. Machines rented or sold on time. Whatever your needs we can best serve you. Write now. Young Typewriter Co., Dept. 204, Chicago.

FOR SALE

U. S. and Foreign military medals, insignias and decorations of all kinds. Ben Sloan, 88-C Chambers St., New York.

PICTURES AND POSTCARDS

TEN exquisite Thanksgiving, Christmas, New Years, Birthday, Comic, or Asbury Park postcards, 10c., 75c per 100. Richard Lavery, Asbury Park, New Jersey.

PATENTS FOR SALE

WE have a few practical money making inventions for sale or trade. Adam Fisher Mfg. Co., 183B, St. Louis, Missouri.

SCENERY FOR HIRE

SETTINGS for Operas, Plays, Minstrels. Plush Drops. Catalog. Amelia Grain, Philadelphia.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

Electrician's Wiring Manual

Tools and Symbols—Preliminary Suggestions on Building Wiring—Moulding—Flexible Conduit—Rigid Conduit—Fixtures and Their Installation—Switches—General Suggestions on House Wiring—Installing Household Electrical Utensils—Wires and Cords—Motors—Transformers—Switchboards and Panels—Motion Picture Theater—Bell Circuits, Annunciator Circuits, Gas Lighters, Burglar Alarms, Bell Transformers, Door Lock—Elevators—Wiring in Damp Places—Outside Wiring—Grounding and Ground Detectors—Inspector's Report on a Defective Electrical Equipment—Estimating and Specifications—Tables and Formulas—Electrical Circuits, Calculation of Wiring, Line Losses and National Electrical Code Discussed for the Beginner—Alternating Currents Simply Explained—Some Things the Electrician Should Know About Storage Batteries—Underwriters' Requirements in the Installation of Wireless Telegraph Equipment—Practical Kinks.

There are many formulas and tables which are of great value to the electrician.

This is a book every wide-awake electrician or any one who wishes to do any wiring should own. Don't take chances, but be sure your work will pass the fire inspector. This manual may save you 100 times the price of the book.

448 Pages, 414 Illustrations, Handsome Flexible binding. Pocket size. Price, postpaid, \$2.50.

Experiments With 110-Volt Alternating Current

By J. D. ADAMS

Here at last is a book that develops a practical working familiarity with the alternating current—the form in which electricity is used in every home. The author shows how this can be done in an interesting and inexpensive way.

The only way to gain a thorough understanding of electricity as it is used commercially is by direct personal experiment. The knowledge thus gained is of vastly more value and importance than that acquired from the performance of the stereotyped series of battery experiments so uniformly described in the text-books.

256 pages, 135 illustrations. Price, postpaid, \$1.75

Construction of Small Alternating Current Motors

By PROF. A. E. WATSON
Brown University

This book contains complete instructions for building small alternating current motors in several sizes. The designs will be found in harmony with those of the very best manufacturers and they can be worked out by the amateur for making useful instruments.

Some of the subjects taken up are "Characteristic Features of Alternating Current Motors," "Construction of a One-Half Horsepower, Single Phase Induction Motor," "Procedure in Testing and Using an Alternating Current Generator or Synchronous Motor." Clear, concise directions and careful drawings are features of this book.

Fully Illustrated.

Price, \$1.50

Popular Science Monthly
225 West 39th Street, New York



"We've got to hold Holloway!"

HE came in to see me this morning and said the National people had offered him \$5,000 a year. We've got to meet that offer! We've got to hold Holloway.

"He's got just the training and the knowledge we need. We can't afford to lose him. He's the most valuable man in his department.

"It's wonderful what that fellow has done. Out of a \$20 a week man, he's made himself a \$60 man and it's taken only a year.

"Since the time I had word from the International Correspondence Schools that Holloway was studying in his spare time he's gone forward by strides. I wish some of the other men would do the same thing. We need more men like Holloway."

EMployers everywhere are looking for men like Holloway—men who want to get ahead—who are willing to devote a part of their spare time to training for advancement.

Are you in this class? How much longer are you going to wait before taking the step that is bound to bring you a better job and more money?

For 30 years the I. C. S. has been helping men and women along the up-road to success in business and in life.

Would you like to be a first-class Mechanical, Electrical or Civil Engineer? A Chemist? An Architect? A Building Contractor? Hundreds of thousands of men have climbed into big jobs in the technical professions through I. C. S. help.

Do you want to advance in Business? In Advertising? In Salesmanship? Many of the country's foremost Advertising and Sales Managers have won success through I. C. S. training.

Accounting? Commercial Law? All over America, bookkeepers, accountants, office managers, private secretaries, are reaping the rewards of time invested in I. C. S. training in these subjects.

It takes but a moment to mark the career of your choice, sign your name, clip out and mail the coupon printed on the right. Yet that simple act has started more than two million men and women toward success.

You have seen it in almost every magazine you have looked at for years. And while you have been passing it by, more than ten thousand men and women each month have been making it the first stepping stone to real success in life.

Will you still turn away from Opportunity? Can you still go on, putting in your days at the same grind, getting the same pay envelope with the same insufficient

sum, when such a little thing can be the means of changing your whole life?

You can have the position you want in the work you like best, a salary that will give you and your family the home, the comforts, the little luxuries you would like them to have. No matter what your age, your occupation, your education, or your means—you can do it.

All we ask is the chance to prove it. That's fair, isn't it? Then mark and mail this coupon. There's no obligation and not a penny of cost. It's a little thing that takes but a moment of your time, but it's the most important thing you can do to-day. Do it now!

TEAR OUT HERE
INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7646-B SCRANTON, PA.

Without cost or obligation, please explain how I can qualify for the position, or in the subject before which I have marked an X in the list below:

- | | |
|---|---|
| <input type="checkbox"/> ELECT. ENGINEER | <input type="checkbox"/> BUSINESS MANAG'MT |
| <input type="checkbox"/> Electric Lighting & Bys. | <input type="checkbox"/> SALESMANSHIP |
| <input type="checkbox"/> Electric Wiring | <input type="checkbox"/> ADVERTISING |
| <input type="checkbox"/> Telegraph Engineer | <input type="checkbox"/> Railroad Positions |
| <input type="checkbox"/> Telephone Work | <input type="checkbox"/> ILLUSTRATING |
| <input type="checkbox"/> MECHANICAL ENGR. | <input type="checkbox"/> Show Card & Sign Ptg. |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Cartooning |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Private Secretary |
| <input type="checkbox"/> Toolmaker | <input type="checkbox"/> Business Correspondent |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> BOOKKEEPER |
| <input type="checkbox"/> CIVIL ENGINEER | <input type="checkbox"/> Stenographer & Typist |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Cert. Pub. Accountant |
| <input type="checkbox"/> MINE FOR'N or ENGR. | <input type="checkbox"/> TRAFFIC MANAGER |
| <input type="checkbox"/> STATIONARY ENGR. | <input type="checkbox"/> Railway Accountant |
| <input type="checkbox"/> Marine Engineer | <input type="checkbox"/> Commercial Law |
| <input type="checkbox"/> ARCHITECT | <input type="checkbox"/> GOOD ENGLISH |
| <input type="checkbox"/> Contractor and Builder | <input type="checkbox"/> Com. School Subjects |
| <input type="checkbox"/> Architectural Draftsman | <input type="checkbox"/> CIVIL SERVICE |
| <input type="checkbox"/> Concrete Builder | <input type="checkbox"/> AUTOMOBILES |
| <input type="checkbox"/> Structural Engineer | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> PLUMBING & HEAT'G | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Sheet Metal Worker | <input type="checkbox"/> Navigation |
| <input type="checkbox"/> Text. Overseer or Bupt. | <input type="checkbox"/> Agriculture |
| <input type="checkbox"/> CHEMIST | <input type="checkbox"/> Poultry |
| <input type="checkbox"/> Pharmacy | <input type="checkbox"/> Banking |
| | <input type="checkbox"/> Spanish Teacher |

Name _____ 7-1-21

Street and No. _____

City _____ State _____

Occupation _____



No need for any man to remain where advancement is slow and the pay small. Drafting opens the way to important positions and high salaries. Many draftsmen earn \$60 to \$150 a week and are in line for promotion to even higher places.



Big Jobs Ready—

Not enough really expert Draftsmen are available for the higher positions that are open—which means that opportunities are always waiting for the man who can qualify. Factories, architects, electrical plants, contractors, sheet metal works, engineering concerns are constantly on the search for proficient Draftsmen.

Train Under the Chicago "Tech" Experts

The Practical engineers at Chicago Technical College will give you training which will make you also an expert. They will teach you the methods they use in their own work—prepare you to step into a paying position. This at the College or by mail. Small fees. Easy terms.

Learn by Mail

FREE Lesson

Trial lesson is sent to show you how we instruct by mail. No cost to you. Just send coupon. Get the lesson, catalog, etc., also free outfit offer.

SEND Act—to-day. Put X in the coupon to show which course interests you—then mail it.

CHICAGO TECHNICAL COLLEGE
1231 Chicago "Tech" Bldg., Chicago, Ill.

Send Free information on subject marked X:

- | | |
|---|--|
| <input type="checkbox"/> Machine Drafting | <input type="checkbox"/> Auto. Engineering |
| <input type="checkbox"/> Electrical Drafting | <input type="checkbox"/> Aero. Engineering |
| <input type="checkbox"/> Architectural Drafting | <input type="checkbox"/> Plan Reading—Buildings |
| <input type="checkbox"/> Structural Drafting | <input type="checkbox"/> Estimating—Buildings |
| <input type="checkbox"/> Sheet Metal Drafting | <input type="checkbox"/> Plan Reading—Machinery |
| <input type="checkbox"/> Topographic Drafting | <input type="checkbox"/> Plumbing, Heating, etc. |
| <input type="checkbox"/> Surveying | <input type="checkbox"/> Steam Engineering |

Name.....

Address.....

Post Office State.....

College or Home Study, State which.....

Free Trial Lesson Included When Inquiry Is for Drafting or Plan Reading.

PRINTING, ENGRAVING, MULTIGRAPHING

100,000 1 x 2" Labels, \$33.00. 3,000, \$2. Save 30% Wolf Labels, Station E, Philadelphia.

250 BOND Letterheads and 250 Envelopes for \$2.75. Write for Pricelist and Samples. Balkow Printing Company, Meriden, Connecticut.

LETTERHEADS, Envelopes, 500 \$2.65. Samples Free. Quality Printery, Marietta, Ohio.

BETTER printing for less money! Send for our large package of samples of hundreds of items every user of printing is interested in. These samples worth dollars will be sent for 10 cents to pay postage. Ernest Fantus Company, 525 South Dearborn Street, Chicago.

PRINTING—The Better Kind. Gummed Labels, etc. May we quote you on your needs? Olde Tye Press, 328 Richards Avenue, S., Dover, New Jersey.

EMBOSSED Business, Personal Stationery, Samples, Stamp. Daniels P. Company, Pittston, Pennsylvania.

QUALITY PRINTING—1,000 Letterheads, Envelopes, Cards or Statements, \$3.00. Gum Labels 50c. per 1,000 up. Multigraph Letters, \$5.00 1,000. Samples free. Howlett's, Paris, Illinois.

PRINTING of every description. Our prices talk. Samples Free. A. H. Kraus, 409 Chestnut Street, Milwaukee, Wisconsin.

QUALITY Printing for less—1000 Letterheads or Envelopes \$3.00. Economic Printery, Leonia, New Jersey.

250 Letterheads or envelopes, \$1.50. Other printing Samples stamp. H. Roney, Paris, Missouri.

SEND 2c for our Samples before ordering. "Mailor-press, 2818 Congress, Chicago.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

GUMMED LABELS

CATALOGUE, samples free. American Gummed Label Co., Dover, New Jersey.

INFORMATION

RELIABLE information furnished on any subject or money refunded, 50c. Co-Operative Service, Times Plaza Box 864, Brooklyn, New York.

INFORMATION furnished. All subjects. Charge \$1.00 per subject. Money back guarantee. Answerall Information Bureau, 463 East 185th Street, New York.

DOGS—BIRDS—PETS

RABBIT Hounds, Foxhounds, Coon, Opossum, Skunk, Squirrel Dogs, Setters. Circular 10c. Brown's Keameis, York, Pennsylvania.

EDUCATIONAL AND INSTRUCTION

LINCOLN-JEFFERSON University. Home study in Academy College, Theological, Law, Music, Pharmacy, Business and Graduate Schools, leading to degrees. Lock Box 239G, Chicago.

FREE. Learn to write Advertisements. Accept position or work home evenings, country, city, selling your "copy" by mail. I made \$100,000.00. Sample Lesson sent free. Williams, Department F, 74 Cortlandt Street, New York.

BOOKKEEPING self-taught in a week. Send \$2 for "Duke's Columnar Bookkeeping" containing complete charts and explanations. Newton Dukes, Fox Street Station, New York.

EARN \$55 to \$150 a week. Learn Mechanical Drawing. Complete Course in short time. Easy payments. Diploma when qualified. No interference with present occupation. Uncrowded field with more positions than we can fill. Albany Institute Mechanical Drawing, Dept. C, Lock Box 84, Albany, New York.

INVESTMENTS

UNUSUAL Investment Opportunity! Make your money do triple duty. Save lives. Save property damage, earn profits, becoming stockholder manufacturing Safety Device. Write for particulars. Inventors, Haas-Frederick Corp., Allentown, Pennsylvania.

GAMES AND ENTERTAINMENT

FOUR Magic Catalogs and Samples—15c. Glimagico, Morgan Park, Illinois.

250 Parlor Tricks, 25c; Big Catalog, 2c. Harvey Teeple, Decatur, Indiana.

MAGIC Entertainment Supplies, Jokes, Novelties, Cardtricks, Illusions, Crystal Gazing Acts, Sensational Escapes, Books. Big Illustrated Professional catalog free. 55 Stage Illusions catalog 25 cents. Be a Handcuff King—20 Sensational Escape Secrets \$1.00—Special Bargain. Heaney Magic Company, Desk 110, Berlin, Wisconsin.

"MARGO" psychic hall—Will mystify, baffle and amaze your friends. Something new, novel and entertaining. Descriptive circular free. James T. Herr, 2919 W. North Ave., Baltimore, Maryland.

TRICKS, jokes and puzzles. Get our catalogue first. Agents Supply House, Binnewater, New York, Dept. P.S. 9.

PLAYS, musical comedies and revues, minstrel choruses, blackface skits, vaudeville acts, monologs, dialogs, recitations, entertainments, musical readings, stage handbooks, make-up goods. Big catalog free. T. S. Denison & Co., 623 So. Wabash, Dept. 26, Chicago.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

BE A RAILWAY TRAFFIC INSPECTOR

Many Openings at Good Pay

Earn up to \$250.00 and \$300.00 per month, expenses paid, in this fascinating new profession. Interesting, pleasant work; travel or remain near home. Brings you in contact with prominent railway officials; splendid opportunities.

We Guarantee You a Position

Prepare in three months spare-time study at home. Any average man can qualify. We then guarantee you a position at \$110.00 a month, expenses paid, or refund your money. You take no risk.

Don't Delay—Investigate Now

while more are needed than are trained. Send today for free Booklet No. D-402.

Standard Business Training Institute

BUFFALO,
N.Y.



WRITE THE WORDS FOR A SONG

We revise poems, write music and guarantee to secure publication by a New York Music Publisher. Our Lyric Editor and Chief Composer is a song-writer of national reputation and has written many big song-hits. Submit poems on any subject. We examine them free.

BROADWAY STUDIOS

249A Fitzgerald Bldg., Broadway at Times Sq., New York.

Wrestling Book FREE



Learn to be an expert wrestler. Know scientific wrestling, self-defense, and jiu-jitsu. Develop a splendid physique, and have perfect health. Join this popular school and learn by mail. The famous world's champions—the marvelous

Frank Gotch and Farmer Burns

offer you a wonderful opportunity. Wrestling is easily and quickly learned at home by mail. Men and boys write now for splendid free book. Learn all the science and tricks. Be able to handle big men with ease. Accept this wonderful offer NOW. Send for free book today, stating your age.

Farmer Burns School of Wrestling, 1789 Range Bldg., Omaha, Neb.



Hotels Need Trained Executives

Nation-wide demand for trained men and women in all departments of hotels, clubs, and apartment houses. Uncrowded field; fine living, quick advancement in the big hotels of the United States—now America's Fourth Largest Industry. Statistics show that ONE IN EVERY TEN HOTELS WILL HAVE AN OPENING FOR A MANAGER THIS YEAR. Thousands of other positions also open to those who qualify through training.

The Lewis School guarantees to give you the valuable knowledge that it has taken some of the most successful hotel men years to obtain—men who are now making \$5,000 to \$50,000 a year. All of your training will be under the personal direction of Clifford Lewis—a hotel expert of national reputation. A few spare-time hours a week given to the simple, clear lessons of the course opens the way to a good position, a fine living, and a handsome salary. The training will in no way interfere with your present activities.

Send today for FREE BOOK "Your Big Opportunity." Don't wait a minute—you may lose the opportunity of a lifetime. Mail the coupon NOW. Your whole future may depend on it.

Founded 1916
Lewis Hotel Training School
Room 2719
Washington, D.C.

Send me without
obligation the FREE BOOK
"Your Big Opportunity."

Name ..
Street ..
City ..
State ..

FOR MEN AND WOMEN

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

GENUINE Indian Baskets—Wholesale. Catalogue. Franklin Gilham, Kelseyville, California.

"SEXUAL Philosophy." 12c. Clear, specific, authoritative, complete, best, satisfies. Fred B. Kaessmann, Lawrence, Massachusetts.

DETECTIVES—Excellent opportunity. Fascinating work. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, New York.

5 MASTER Keys and Novel Key Chain, \$1. Open and test thousands of different locks. They have satisfied thousands of purchasers and are used and recommended by locksmiths, janitors, detectives, firemen, policemen, travelers, etc. Master Key Company, 40 Manhattan Building, Milwaukee, Wisconsin.

ARE You Interested in your future? Trial reading for birthdate and 10c. F. Crane, 834 Advertising Bldg., Chicago.

SUCCESS or failure—which is your destiny? Scientific information. "Success" pointers and personality sketch for 10c and birthdate. Thompson-Heywood, Dept. 700, Chronicle Bldg., San Francisco, California.

YOUR horoscope covering full year for 35c. Includes an extensive reading, valuable daily guide, large pictorial chart and special forecasts for each month. Scientific, complete. Try it! Money back if dissatisfied. Give birthdate. Address L. Daniels, Flatbush Sta., Box 32, Brooklyn, New York.

MAGIC Words—Amazing sure method of obtaining your desires. Postpaid for dime. Smedley, 145 Miller, Brooklyn, New York.

START Oil Painting, Landscape, and Portrait Studio. Quickly learned, no brushes used, no transfer or chemicals no apparatus necessary, no special talent or experience required. Outfit furnished, free booklet. Tangle Company, 127 Main, Muscatine, Iowa.

SEX Books for Adults. Illustrated catalog, 4c. Smetana & Co., Owosso, Michigan.

GENUINE Cow-hide Brief Cases: 3 Pocket, \$5.00. Splendid Xmas Gift. Thomas Mfrs. Sales Co., Kennett Square, Pennsylvania.

TATTOOING Supplies. Learn the game. Catalogue 10c. Prof. Waters, 1050 Randolph, Detroit.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

PHOTOGRAPHY AND SUPPLIES

FILMS developed 5c roll, prints 3c each. Photo Service, 929 McMillan, Cincinnati, Ohio.

MAIL us 20c with any size film for development and six velvet prints. Or send six negatives any size and 20c for six prints. Or send 40c for one 8 x 10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Company, 212 Bell Avenue, Roanoke, Virginia.

HAVE You A Camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 156 Camera House, Boston, 17, Massachusetts.

HIGH GRADE Amateurs only, send us 25c, with first roll. Pay a little more and see the difference. Priddy Photo Co., Columbus, Nebraska.

KODAK films—any size, developed, 10c. Prints 4c and up. Quality work. Trial order solicited. Machiel's Studio, Benton, Ill.

ATTENTION—Send your favorite Film Negative and 25c for sample 1922 Calendar handtinted. AZ-U-LYK-M Photo Service, Bristol, Vermont.

PHONOGRAHS, RECORDS, ETC.

BUILD your own phonograph. "Perfection" highest quality spring and electric motors, tonearms, reproducers cabinets finished or knocked down. Pre-war prices. New illustrated catalog and building instructions free. Federal Supply Company, Indianapolis, Indiana.

BUILD a genuine Choraleon phonograph and save over half. Big profit building and selling. We furnish motors, tone-arms, full instructions and all necessary parts. Send for catalog and free blueprint offer. Choraleon Phonograph Co., 1121 12th St., Elkhart, Indiana.

PHONOGRAPH parts: Complete finished cabinets \$23.00 and up. Electric Motors Complete \$21.00. Spring motors complete \$11.00 and up. Tone-arms \$2.00 and up. Columbia and Emerson records 39c each. Violinola Company, Dept. 7, Port Huron, Michigan.

BUILD your Phonograph. "Perfection" high quality spring and electric Motors, Tone Arms, Reproducers, wonderful results. Big saving. New catalog and building instructions mailed for ten cents. Hoosier Manufacturing & Supply Co., Phonograph Supply Dept., 316 Baldwin Block, Indianapolis, Ind.

BOOKS AND PERIODICALS

6 DIFFERENT, interesting, clever publications, prepaid to any address only 25c. Publishers' price \$1.50. All current issues. Satisfaction guaranteed. Walhamore Company, Lafayette Bldg., Philadelphia, Pennsylvania.

PERSONAL Power Books. They reveal your latent possibilities, impart health, happiness and success. Sample copy 35c. Mutual Supply Co., Bradford, Pennsylvania.

BOOKS. All kinds. Lists. Higene's, K2441 Post Street, San Francisco.

MUSICAL INSTRUMENTS

VIOLINS, deep, mellow, soulful—on credit. Easy terms for wonderful instruments. Get details today. Gustav L. Henning, 2424 Gaylord St., Denver, Colorado.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

Wonder Electric Generator

Brushes Pain Away—From Head to Foot



**30 days TRIAL
For Health
and Beauty**

Makes Its Own ELECTRICITY!

**NO Batteries
Cords
Replacements**

No Shocks
No Pains
Pleasant and
Invigorating

READ

"I have never made a better investment. It is a pleasure to use the Generator and enjoy the relief and quieting sensation of the never-after-a-hard-day's-work" E. A. W., Mont. (Name on request)

"I have used it to relieve an old lady of sciatica, and she is now able to walk with freedom from pain." J. J. A., Minn. (Name on request)

"Has relieved me of pleasure, and I have also found it to be the best remedy for severe headaches." H. H., Ohio. (Name on request)

**Free
Offer
Coupon**

McKinley, Stone
& Mackenzie
Sole American Distributors
Dept. 1412, 30 Irving Place, N.Y.

CUT THE COUPON HERE
Send me your Free Book and
30 Days' Trial Offer on the
Wonder Electric Generator.

Name.....

Address.....

**FREE! New Book and
30 Day Trial Offer**

Just mail the coupon or postal card at once! Get our new book explaining Wonder Electric Generator treatments for all parts of the body. Read about this remarkable invention—a hand operated machine that MAKES ELECTRICITY without batteries, and without an electric connection of any kind! Stop suffering with pains. Stop being bothered by falling hair and plainly complexion. Find out what the Wonder Electric Generator has done for others. Write TODAY for special 30 days trial offer, and introductory price!

McKinley, Stone & Mackenzie, Sole American Distributors,
Dept. 1412, 30 Irving Place, New York

CIVIL SERVICE

Jobs are good for life. Many men and women needed for Post Office Clerk, Carrier, Railway Mail, Rural Carrier, Po-master, Customs, Internal Revenue and other Departments. With the aid of our

HOME STUDY COURSES

you can quickly prepare for one of these attractive positions. Our system of instruction, adopted by U. S. Gov. schools all over the country, is easy, rapid, and sure of results. Write today for full information.

CHICAGO CIVIL SERVICE COLLEGE, Lock Box 226-X, Chicago, Ill.

**You Can KNOW
all about AUTOS,
TRACTORS, AEROPLANES,
STARTING and LIGHTING
SYSTEMS, STORAGE BAT-
TERIES, VULCANIZING, etc.**

Valuable Book FREE

"How to Succeed in the Automobile, Tractor and Aeroplane Business," gives much new and very useful information; also tells all about the many splendid advantages and practical training you can get at this college in a few weeks. Tear this out and write for a copy, FREE, today.

Small Motors, Transfor- mers and Electromagnets

By H. M. STOLLER, B.E., M.S.

Unique, giving typical complete detailed designs and actual construction methods. Practical, tells how to rewind used motors for changes in voltage, speed, frequency, etc. Authoritative, yet simply written, and equally valuable for the amateur, repair man and electrical engineer.

328 pages Price, postpaid, \$3.10

POPULAR SCIENCE MONTHLY

225 West 39th Street, New York City

**GREER. COLLEGE
OF AUTOMOTIVE ENGINEERING
Dept. 50Y 202H S. Wabash Ave.
CHICAGO**

LANGUAGES

WORLD ROMIC. General Phonetic System, Masterkey to All Languages. Six Textbooks, \$1.75. French Chart, 37c; Spanish Chart, 37c; Speech-Organs Chart, 37c. Sound-Tables, 45 languages, 30c each language: Albanian, Bearinese, Bohemian, Braganeian, Brasui, Burgundian, Catalan, Charente, Cumbrian, Dauphinean, Dutch, English, American English, British English, Scotch English, Middle English, Old English, Finnish, French, Galician, Genoese, German, Greek, Hungarian, Old Icelandic, Italian, Japanese, Latin, Laz, Lorrainian, Norwegian, Picard, Portuguese, Provencal, Old Provencal, Rhetian, Rumanian, Sanskrit, Scotch, American Spanish, Castilian Spanish, Walloon, Welsh, Yorkshire. Languages Publishing Company, 8 West 40th Street, New York.

AUTHORS—MANUSCRIPTS

WRITE for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 400, St. Louis.

WRITERS: Have you a song-poem, story, photoplay, to sell? Submit manuscript now to Music Sales Company, 48, St. Louis.

WRITERS: Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 117, Hannibal, Missouri.

FREE to writers—a wonderful little book of money-making hints, suggestions, ideas; the A B C of successful story and play-writing. Absolutely free. Just address Author's Press, Dept. 15, Auburn, New York.

\$\$\$ FOR IDEAS. Photoplay plots accepted any form; revised, criticised, copyrighted, marketed. Advice free. Universal Scenario Corporation, 904 Western Mutual Life Bldg., Los Angeles.

OPENINGS for Profitable and Interesting Work as Special Correspondent for Motor Magazines. Report races, contests, automobile shows, etc. Make good money in spare time. Need not interfere with your regular occupation. Send application stating age, education and present position, and enclose 25 cents for booklet "The Profession of Opportunity," containing detailed information. Automotive Press Bureau, Post Office Drawer 397-S, Londonville, Ohio.

SCENARIOS published free. With name as author and rights protected. Vern Steves, Del Monte, California

AMBITIOUS writers send today for Free Copy, America's leading magazine for writers of Photoplays, Stories, Poems, Songs. Instructive, helpful. Writer's Digest, 636 Butler Bldg., Cincinnati.

AUTHORS—Learn to write articles and stories. Send ten cents for valuable bulletin. Capital Literary Bureau, Lock Box 513, Department P, Madison, Wisconsin.

MUSIC AND SHEET MUSIC

CORNETISTS, Saxophonists, Trombonists, Clarinetists: Send for Free Pointers on Weak Lips—High Tones, Low Tones, Staccato, Jazzing. Mention instrument. Virtuoso School, Buffalo, New York.

WRITE the words for a song. We revise poems, write music and guarantee to secure publication. Submit poems on any subject. Broadway Studios, 121C Fitzgerald Building, New York.

WRITE a Song Poem—Love, Mother, Home. Comic or any subject. I compose music and guarantee publication. Send words to-day. Edward Trent, 631 Reaper Block, Chicago.

WRITE the words for a song. We will compose music, secure copyright, and print. Submit poems on any subject. Seton Music Company, 920 S. Michigan Avenue, Room 112, Chicago, Illinois.

SONGWRITERS! Learn of the public's demand for songs suitable for dancing and the opportunities greatly changed conditions offer new writers, obtainable only in our "Songwriters Manual & Guide" sent free. Submit your ideas for songs at once for free criticism and advice. We revise poems, compose music, secure copyright and facilitate free publication or outright sale of songs. Knickerbocker Studios, 315 Galety Building, New York.

SONG WRITERS—Send for my free pamphlet, "Song Writers' Secrets." Ethwell Hanson, Room 607, 3810 Broadway, Chicago.

SONG-WRITER'S Booklet Free—A wonderful instructive booklet, "The Song-Writer's Guide" sent absolutely free. Submit your latest song-poems. We write music, print, and secure copyright. The Metropolitan Studios, Room 221, 914 South Michigan Avenue, Chicago.

WRITE the Words for a Song—We write music, copy-right and endeavor to promote popularity and outright sale. Bell Studios, 1940 Broadway, Dept. 711, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

MOTION PICTURE BUSINESS

PHOTOPLAYS Wanted. Big prices paid. You can write them. We show you how. Free particulars. Rex Publishers, Box 175, F 43, Chicago.

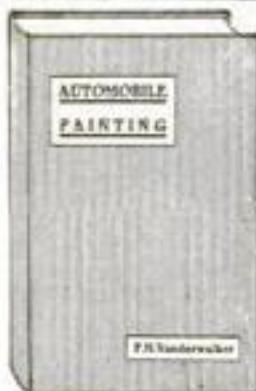
WRITE Photoplays: \$50 each. Experience unnecessary; details free to beginners. Producers' League, 194, St. Louis.

PHOTOPLAY writers earn thousands. Be one; become successful. Learn at home, easily, quickly, at little cost. Free details: write Friedman Company, 5014M Vernon, St. Louis.

SHOW moving pictures in home. Projecting machines \$2.50 up. Illustrated catalog, machines and films, Free. Werner Bros., High Ridge, Missouri.

\$3000 to \$5000 a Year—Cinematography (The Science of Motion Pictures) New; Fascinating; Remunerative. Prospectus Free. American Institute of Cinematography, Inc., Suite 4-A, Steinway Hall Bldg., Chicago, Illinois.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

DRAKE'S PRACTICAL MECHANICAL BOOKS**They Will Raise Your Pay—
Order on 5-Day Trial**

The books listed below will perfect you in your chosen trade—pave the way to the big positions. Written in non-technical language—easy to read and understand. Every book covers its subject completely. An entire course of practical instruction and information condensed into one volume. Drake books make it unnecessary to wade through a big set of books to get the information you want. Your choice sent postpaid—you benefit 5 days—money refunded in full if not entirely satisfactory. Order direct from this page.

Automobile Books

Automobile Ignition, by Manly	Leatherette	\$2.00
Automobile Starting and Lighting, by Manly	Leatherette	2.00
Brookes' Automobile Handbook	Leatherette	2.00
Ford Motor Car, Truck and Tractor, by Manly	Cloth	1.50
Starting and Lighting Troubles, Remedies and Repairs, by Manly	Leatherette	3.00
Automobile Battery, Care and Repair, by Manly	Leatherette	2.00
Automobile Catechism and Repair Manual	Leatherette	1.50
Tires and Vulcanizing, by Tuftord	Cloth	2.00
Gas and Oil Engine Handbook	Cloth	1.50
Automobile Upkeep and Care, by Manly	Cloth	1.50
Motorcycle Handbook, by Manly	Cloth	1.50

Painting Books

Scene Painting and Bulletin Art

A Show at Sho' Cards

Sign Painting

Strong's Book of Designs

Signist's Alphabets

Modern Painter's Cyclopedias

Automobile Painting

Estimates, Costs and Profits, Painting and Decorating

New Hardwood Finishing

The Amateur Artist

New Stencils

Electrical Books

Practical Applied Electricity

Alternating Current

Electric, Motor Control Systems

Wiring Diagrams and Descriptions

Electrical Tables and Data

Armature and Magnet Winding

Modern Electrical Construction

Electricians' Operating and Testing

Motion Picture Operation

Drake's Electrical Dictionary

Electric Motor, Direct, Alternating

Drake's Telephone Handbook

Modern American Telephony

Wireless, Telegraph and Telephone Handbook

Telegraphy Self-Taught

Shop Practice Books

Sheet Metal Workers' Manual

Oxy-Acetylene Welding and Cutting

Leatherette

Slide Rule and Logarithmic Tables

Handbook for Millwrights

Machine Shop Practice

Mechanical Drawing and Machine Design

Pattern Making

Business, Language and Reference Books

Better Business Letters, Leatherette

Better Business English, Leatherette

Better Advertising, Leatherette

French without a Teacher

Spanish without a Teacher

German without a Teacher

Everyday French

Everyday Spanish

Finger Prints Simplified

Practical, Up-to-date Plumbing

Hot Water Heating

Elementary Chemistry

Complete Courses in Civil Service

Cloth

Standard Encyclopedia of Recipes, Cloth

MONEY BACK GUARANTEE

Mark on this page the books you want and send in, with the price. Books will be sent postpaid. If not satisfactory return in five days and money will be promptly refunded. Which books will help you? Mark them now.

BIG CATALOG FREE

Many more Home Self Helps fully described in our new book, sent free. SEND TODAY.

FREDERICK J. DRAKE & CO., Publishers, 1003 Michigan Ave., Chicago

Drake Books are For Sale at all Book Stores

**One Million Dollars
Can't Buy It!**

NEW YORK CITY
July 8th, 1921.

Dear Mr. Liederman:

Six months ago I was a physical wreck, on the verge of tuberculosis. I had tried numerous doctors but none of them seemed to do me any good. One day I met a friend whom I had always envied because of his marvelous physique, and asked him why he had been gifted with such a strong body while I did not have the strength or ambition to enjoy any pleasures in life. "Gifted nothing," said he. "I got this by work." He then told me how he had taken your course in physical training and made himself the man he was. This was my start. I wrote you at once and ere long noticed the complete change in my physical make up. I am now 22 pounds heavier, never know a sick day and feel as though I could lick my weight in wild cats. My boss has also noticed my ability to accomplish bigger things and I have had my salary advanced three times, making a total increase of 60%. I would not change places with my former self for a million dollars.

Yours for bigger things,

OSCAR MOFFITT.

Where Do You Fit?

Are you satisfied with your present condition? Do you start each day full of pep and ambition? Do you feel the thrill of vitality surging through your body? Are you proud of your physical make-up? If not, get busy, steam up and acquire it. It is a possession that money cannot buy. But if you have the spark of manhood in you, you will jump in and get it.

What I Promise

If you are sincere in your endeavor and ready to follow my guidance, I guarantee to completely change you in one month's time. My course will continue on for months, but inside of thirty days your own friends will not know you. Your arm will increase at least one full inch and your chest double in proportion. Your shoulders will broaden and your whole body fill out. You will have the spring to your step and the thrill of life that only an athlete knows. Come then and try me out and make me prove it—I like it.

Send for my new book

"MUSCULAR DEVELOPMENT"

IT IS FREE!

It tells the secret, and is handsomely illustrated with 26 full-page photographs of myself and some of the world's best athletes whom I have trained, also full particulars of my splendid offer to you. The valuable book and splendid offer will be sent you on receipt of only ten cents, to cover wrapping and mailing. Sit right down now and fill in the coupon. The sooner you get started on the road to health and strength the easier it will be to reach perfect manhood. Don't drag along one day longer—mail the coupon to-day.

EARLE E. LIEDERMAN

Dept. 1312, 305 Broadway

New York



EARLE E. LIEDERMAN
"The acme of physical perfection"

Name.....

Address.....

City..... State.....

REAL ESTATE—FARM LANDS

PECAN and Orange Orchards on the Gulf. Easy terms. Big quick returns. Dept. C, Suburban Acres Company, Ocean Springs, Mississippi.

WANT to hear from party having farm for sale. Give particulars and lowest price. John J. Black, 174th Street, Chippewa Falls, Wisconsin.

\$350 Gets "Security" Farm, 20 Acres Edge Village, 12 acres productive tillage; pasture, wood, timber, fruit; 5-room house, barn, poultry house. \$700, only \$350 down. Page 48 Catalogue Free. Strout Farm Agency, 150 BH Nassau St., New York City.

FOR INVENTORS

900 Mechanical Movements, also illustrations explaining 50 Perpetual Motions. My book, Inventor's Universal Educator, Fifth Edition, tells how to procure and sell patents. Government and other costs. Covers the matter from A to Z. 160 pages, elegantly bound. Contains noted decisions of U. S. Supreme and State Courts on Patent Cases. Mechanical Movements greatly assist inventors—suggest new ideas that may prove of great aid in perfecting inventions. Tells how to select an Attorney. Has valuable information regarding Patent Sharks. Selling Agents and Brokers. Price \$2. Postage Free everywhere. Fred G. Dieterich, 681 Ouray Building, Washington, D. C.

PATENTS—Write for free Guide Book and Evidence of Conception Blank. Send model or sketch of invention for free opinion of its patentable nature. Highest references. Reasonable terms. Victor J. Evans & Company, 106 Ninth, Washington, D. C.

THE G. & G. Manufacturing Company, 3116 Spring Grove Avenue, Dept. A, Cincinnati, Ohio. Special Machinery, Models, Dies, Patterns, Tools, Metal Stampings, Gears, Contract Manufacturing.

PATENTS—Send for free book. Contains valuable information for inventors. Send sketch of your invention for Free Opinion of its patentable nature. Prompt service. (Twenty years' experience.) Talbert & Talbert, 436 Talbert Building, Washington, D. C.

INVENTORS, before disclosing your ideas to others write for our "Evidence of Disclosure" form. Send sketch or model of your invention for examination and advice. Ask for free book "How to Obtain a Patent." Avoid dangerous delays. Write to-day. Merton-Roberts & Co., 121 Mather Bldg., Washington, D. C.

PATENTS Secured. Prompt service. Avoid dangerous delays. Send for our "Record of Invention" form and Free Book telling How to Obtain a Patent. Send sketch or model for examination. Preliminary advice without charge. Highest References. Write today. J. L. Jackson & Co., 121 Ouray Bldg., Washington, D. C.

HAVE you a practical invention to sell outright or place on royalty? Send details to Adam Fisher Mfg. Co., 183A, St. Louis, Missouri.

MODELS and Experimental Work of every description. Lamson Model and Experimental Works, 625 West Jackson Boulevard, Chicago.

I SELL Patents. Established in 1900. Charles A. Scott, 773PS, Garson Avenue, Rochester, N. Y.

PATENTS—Trademarks. Before disclosing an invention, the inventor should write for my blank form "Evidence of Conception." This should be signed, witnessed and returned to me with sketch or model upon receipt of which I will promptly render opinion as to patentable nature and send booklet on Patents. Highest references. Prompt attention. Reasonable terms. Clarence A. O'Brien, Registered Patent Lawyer, Woodward Building, Washington, D. C.

INVENTORS—Will buy outright or arrange to manufacture on liberal royalty basis, patented or patentable inventions which meet our requirements. Principal parts should be of brass or steel and adaptable to screw machine production up to one inch in diameter. Complete factory fully equipped with going organization for both manufacture and sales. Submit models or drawings with complete description. F. H. Wellington, 1055 Riverside Drive, South Bend, Indiana.

WE sell patents. Write for information P. O. Box 1081, San Francisco, California.

PATENT ATTORNEYS

PATENTS—Herbert Jenner, Patent Attorney and Mechanical Expert, 622 F Street, Washington, D. C. I report if a patent can be had and its exact cost. Send for circular.

PATENTS—Inventors should write for our book "How to Obtain a Patent," which contains valuable information which every inventor should have. If you will send us a sketch, model or photograph of your invention we will promptly make search of the Patent Office records and advise you whether or not your invention is in our opinion patentable; our charge for the service being \$5.00. With an experience of over twenty years we feel that we are fitted to render you prompt, efficient service which will merit your confidence. Moderate charges. Write to-day. Talbert & Talbert, 435 Talbert Bldg., Washington, D. C.

PATENTS. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F Street, Washington, D. C.

PATENTS—Write for free illustrated Guide Book and Evidence of Conception Blank. Send model or sketch of invention for free opinion of its patentable nature. Highest references. Prompt attention. Reasonable terms. Victor J. Evans & Company, 155 Ninth, Washington, D. C.

ROBB, ROBB & HILL offer a strictly professional service to manufacturers and inventors in patenting inventions and registering trade-marks, a service which is the result of twenty years' experience. Write for free booklet and names of prominent manufacturers and inventors represented by us. Send sketch for preliminary advice. 840 McLachlan Building, Washington, D. C. 1336 Hanna Building, Cleveland.

LACEY Patent-Sense. "The book the inventor keeps." Free. See page 116.

PATENTS promptly procured. Send disclosure of invention, design or trademark for actual search of U. S. patents and novelty report. Validity and infringement investigations. Patent and trademark suits prosecuted and defended anywhere in the United States. Discriminating clients appreciate my efficient service. No literature will be sent you as this is a professional service. Individual and personal. Specific information and advice given regarding each individual case. Specialize in prosecution of pending cases that have been previously rejected by the Patent Office. Specialize also in unfair competition litigation before the Federal Trade Commission. George P. Kimmel, Master of Patent Law, 38N, Loan and Trust Building, Washington, D. C.

PATENTS, Trade Marks, Copyrights. Prompt, personal, reliable service. Over 30 years' active practice. Write for terms. Book free. Address E. G. Siggers, Box 1, N. U. Building, Washington, D. C.

"INVENTOR'S Guide" free on request; gives valuable information and advice. Frank Ledermann, 15 Park Row, New York.

"O.K."

say

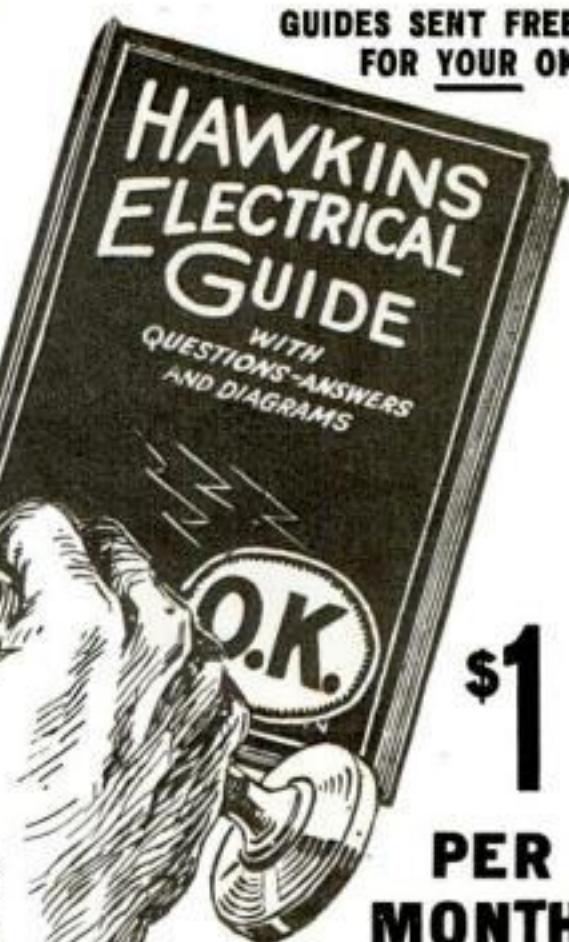
5000

READERS

"Worth ten times their price." "I wouldn't send them back for a handful of diamonds." "I congratulate you on their excellence." "Helped me to two raises in four months." "Better than a school of instruction." "Studied them when I was laid up and got further ahead than if I'd been on the job."



GUIDES SENT FREE
FOR YOUR OK



These are the words of gratitude that come to us by every mail from Electrical workers. There is no short cut to genius. But there are sign posts all along the road to success. Hawkins Electrical Guides find these sign posts for you. It is so easy to pay for the Guides that you will scarcely miss the monthly payments.

HAWKINS ELECTRICAL GUIDES

Do you want to know the facts about the following electrical subjects? They are all covered in Hawkins Electrical Guides.

Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutator brushes. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamos and motors—galvanometers—standard cells—current measurement—resistance measurement—voltmeters—wattmeters—watt-hour meters—operation of dynamos—operation of motors. Distribution system—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems. Alternating current principles—alternating current diagrams—the power factor—alternator principles—alternating construction—windings. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors—induction, motors, transformers; losses, construction, connections, tests—converters—rectifiers. Alter-

nating current systems—switching devices—circuit breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards. Alternating current, wiring power stations—turbines; management, selection, location, erection, testing, running, care and repair—telephones. Telegraph—simultaneous telegraphy and telephony—wireless—electric bells—electric lighting photometry. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles. Elevators—cranes—pumps—air compressors—electric heating, electric welding—soldering and brazing—industrial electrolysis—electro-plating—electro-therapeutics—X-rays.

Also a complete 126-page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 Electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

4700
PICTURES
3500
PAGES

Flexible Covers
Pocket Size

FREE

Examination
Coupon

SEND NO
MONEY

SEND ONLY THIS COUPON

THEO. AUDEL & CO.,
72 Fifth Ave., New York City

Please submit me for free examination, HAWKINS ELECTRICAL GUIDE (Price \$1 each). Ship at once prepaid, the 10 numbers. If satisfactory, I agree to send you \$1 within seven days and to further mail you \$1 each month until paid.

Name.....

Occupation.....

Employed by.....

Home Address.....

Reference.....



\$100 a Week!

*He doubled his pay
and now enjoys the comforts and
pleasures of a real income*

Why not double your pay? Thousands of our students have done it and thousands more will do it. You can be one of them. Do not think for a moment that it is luck or pull which brings success and real money—far from it. It is preparing for the big opportunity and knowing what to do when the right time comes that does it. The men who have made successes for themselves were ready when their main chance came. Your main chance, too, will come. Are you ready for it?

Remember the Empty Lot?

The older fellows were playing ball and you were watching, wondering if you would ever get a chance to play. You knew if you only got a chance you would show them. Sure enough, one day they hollered, "Come on, kid, grab a bat!" Your chance at the pill had come. That is the way with life. Your chance at the pill will come, but if you want to stay on the team, you will have to deliver the goods—and that you can do only if you are prepared. The big money and the permanent job go to the man "who knows."

You Can be the Man "Who Knows"

We will show you how. Without loss to you of a single working hour, we can show you a sure way to success and big pay. A large number of men in each of the positions listed are enjoying their salaries because of our help. We want to help you. Make a check on coupon against the job you want and we will help you get it. Write or print your name on the coupon and send it in today.

AMERICAN SCHOOL
Dept. G-915, Drexel Ave. and 58th St., Chicago

AMERICAN SCHOOL
Dept. G-915, Drexel Ave. and 58th St., Chicago
Send me full information on how the PROMOTION PLAN will help me win promotion in the job checked.

Architect	Lawyer
Building Contractor	Machine Shop Practice
Automobile Engineer	Photoplay Writer
Automobile Repairman	Mechanical Engineer
Civil Engineer	Shop Superintendent
Structural Engineer	Employment Manager
Business Manager	Steam Engineer
Cert. Public Accountant	Foremanship
Accountant and Auditor	Sanitary Engineer
Bookkeeper	Surveyor (& Mapping)
Draftsman and Designer	Telephone Engineer
Electrical Engineer	Telegraph Engineer
Electric Light & Power	High School Graduate
General Education	Fire Insurance Expert

Name _____
Address _____

PATENT. Trade-mark and Copyright specialist. Prompt, personal and efficient service. Advice on request. M. E. Jones, Lawyer, 509C 7th Street, Washington, D. C.

INVENTORS, send sketch or model of your inventions for opinion concerning patentable nature and exact cost of applying for patent. Book, "How to Obtain a Patent," sent free. Gives information on patent procedure and tells what every inventor should know. Established twenty-eight years. Chandee & Chandee, 427 Seventh Street, Washington, D. C.

INVENTORS before disclosing your idea to others write for our "Evidence of Disclosure" form. Send sketch or model of your invention for examination and advice. Ask for free book "How to Obtain a Patent." Avoid dangerous delays. Write to-day. Merton-Roberts & Co., 120 Mather Bldg., Washington, D. C.

PATENTS. My fees in installments. Advice book free. Frank Fuller, Washington, D. C.

MONROE MILLER, Ouray Building, Washington, D. C., patent attorney, mechanical and electrical expert. Best quality of work and results. Moderate charges.

INVENTORS—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Allwine, 232 Ouray Building, Washington, D. C.

PATENTS procured—trade marks registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Building, Washington, D. C., or 2276-Z Woolworth Building, New York.

PROTECT your rights. Write for "Record of Invention" which contains form to establish evidence of conception of your invention. Prompt personal service. Preliminary advice without charge. J. Resney Kelly, 612-P Columbian Building, Washington, D. C.

"INVENTORS' Record" and "Bulletin" sent without charge. My free blank form for disclosing your invention simplifies procedure. Send sketch or description for preliminary advice. Wm. H. Mulligan, Registered Attorney, 396 Woodward Building, Washington, D. C.

PATENTS, prompt, personal, efficient service by an Attorney-at-law skilled in all branches of Patent practice. Over 12 years' actual experience. Full information on request. B. P. Fishburne, 323 McGill Building, Washington, D. C.

PATENTS. Prompt, personal, efficient service. Over 15 years' actual experience in various branches of Patent Practice. Send sketch, model or photos and description. Lynwood B. James, 392 McGill Bldg., Washington, D. C.

PATENTS procured. Trade-marks registered. Reasonable fees. Theodore Willis, Registered Patent Attorney, Munsey Bldg., Washington, D. C.

GET Your Own Patent. \$35 Complete. Application blanks and full instructions \$1. Cooper Cutting, Campbell, California.

INVENTORS: If you have an invention and don't want to spend unnecessary money in securing a patent, write to Inventors & Engineers Consulting Co., P. O. Box 344, Washington, D. C.

PATENTS—Trademarks. Before disclosing an invention, the inventor should write for my blank form "Evidence of Conception." This should be signed, witnessed and returned to me with sketch or model upon receipt of which I will promptly render opinion as to patentable nature and send booklet on Patents. Highest references. Prompt attention. Reasonable terms. Clarence A. O'Brien, Registered Patent Lawyer, Woodward Building, Washington, D. C.

PATENTS—Edward C. Sasnett, Attorney at Law and former Principal Examiner in the United States Patent Office; Electrical and Mechanical Expert. Personal service guaranteed. McGill Building, Washington, D. C.

PATENTS Secured. Prompt service. Avoid dangerous delays. Send for our "Record of Invention" form and Free Book telling How to Obtain a Patent. Send sketch or model for examination. Preliminary advice without charge. Highest References. Write today. J. L. Jackson & Co., 222 Ouray Bldg., Washington, D. C.

AGENTS AND SALESMEN WANTED

AGENTS make 500% profit handling Auto Monograms New Pictures, Window Letters, Transfer Flags, Novelty Signs. Catalog Free. Hinton Co., Dept. 125, Star City, Indiana.

MAN in each town to refinish chandeliers, brass beds, automobiles, by new method. \$10 daily without capital or experience. Write Gunmetal Company, Avenue "F," Decatur, Illinois.

MAKE \$314 Monthly selling patented vest-pocket windshield cleaner. Firms made this first month: one rub keeps entire windshield clear 24 hours; chemical-felt; enameled mountings; guaranteed one year; sells \$1. Security Mfg. Co., Dept. 361, Toledo, Ohio.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Company, Dept. 467, Amsterdam, New York.

BEGINNERS—Complete Mail Order System Book. Box 1005, Atlantic City.

AGENTS make 140% profit. Eradium (luminous) Crucifix shines in the dark. Sells for \$2.00. Costs 84c. Complete line religious articles, Crucifixes, bulbs, switch plates, house numbers, match boxes. Novel! Ornamental! Useful! Every home a prospect. Big sales. Get Free Demonstration Outfit. The Pioneer Corporation, 1263 W. 63rd St., Chicago, Illinois.

IF you are now selling twisted wire brushes, toilet articles, mops or household specialties, you should carry our side line. Sanitax Hair Brushes, etc., do not conflict with any other line. Splendid profit makers. Sanitax Brush Co., 2332 Wabash Avenue, Chicago.

SALESMEN for Patented Cigar Lighters and Clear Case Moisteners. Sell to Cigar Stands everywhere. Thousands in use. Exclusive or side line. Start now. Drake Mfg. Co., Dept. P., Milwaukee, Wisconsin.

BIG Money and Fast Sales. Every owner buys Gold Initials for his auto. You charge \$1.50; make \$1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Company, Dept. 47, East Orange, New Jersey.

PATENTS. Write for Free Illustrated Guide Book. Send sketch or model for free opinion of its patentable nature. Highest references. Prompt attention. Reasonable terms. Victor J. Evans & Co., 174 Ninth, Washington, D. C.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Particulars free. Stalrite Company, 115 Second Avenue, New York.

AGENTS, Mail Order Men, get this new Ripper. Shuts up like a knife, uses razor blades. Sample, 30c. Caribet Co., Berrien Springs, Mich.



WE'LL TRAIN YOU as Drafting Specialist **FREE**

EARN \$35 TO \$100 A WEEK

After you have completed our Course in Drafting (mechanical drawing), we will give you free training in your choice of one of our courses in a specialized branch of drafting.

WHAT YOU GET FREE

We also furnish you free with complete drawing and drafting equipment when you enroll in our Course. Free consultation privileges at any time, during your course or after you've taken your position. We help you to get a position as draftsman and send you free subscription to Draftsman's Publication "The Compass."

FREE BOOK: Write to-day for free book, "Your Future in Drafting," giving details of our home study course in drafting and telling how you can qualify for a position paying \$35 to \$100 a week.

ROY C. CLAFLIN, President

COLUMBIA SCHOOL OF DRAFTING
Dept. 1573, 14th and T Streets, N. W., Washington, D. C.

"STAMMERING Its Cause and Cure"

You can be quickly cured. Send 10 cents for 288 page cloth bound book on Stammering and Stuttering. It tells how I cured myself after Stammering and Stuttering for 20 years. BENJAMIN N. BOGUE, 685 Bogue Building, 1147 N. Ill. St., Indianapolis.



Home-Study Business Courses

Do you want an important, high-salaried position? You can have one if you can do the work. LaSalle experts will show you how, guide you step by step to success and help solve your personal business problems. Our plan enables you to train during spare hours without interference with your present duties. Give us your name and address and mark with an X below the kind of position you want to fill. We will mail catalog and full particulars regarding our low cost monthly payment plan. Also our valuable book for ambitious men, "Ten Years' Promotion in One." Tear out, mark and mail the coupon today. No obligation to you. Find out about the new "LaSalle Problem Method," what it is and how it works. Let us prove to you how this step has helped thousands of ambitious men to real success. Check and mail the coupon now.

—Coupon—
LaSalle Extension University

Dept. 1283-R Chicago, Ill.

Gentlemen: Send without obligation to me information regarding course indicated below, also copy of your interesting book, "Ten Years' Promotion in One."

- Business Management
- Banking and Finance
- Higher Accountancy
- C. P. A. Coaching for Advanced Accountants
- Traffic Management—Foreign and Domestic
- Modern Foremanship
- Employment Management
- Railway Accounting and Station Management
- Personnel and Employment Management
- Business English
- Commercial Spanish
- Industrial Management Efficiency
- Effective Speaking
- Expert Bookkeeping
- Business Letter-Writing



Name _____

Present Position _____

Address _____

Copyrighted material

"RADIO" Luminous Paint—Makes any article visible in the dark. Guaranteed. Bottle 50 cents each. Illuminant Company, 5428 LP Rice Street, Chicago.

FORDS run 34 miles per gallon on cheapest gasoline or half kerosene, using our 1922 carburetor. Increased power; styles for all motors; attach yourself. Money back guarantee; 30 days trial. Big profits to agents. Air Friction Carburetor Co., 3222 Madison St., Dayton, Ohio.

56 MILES per gallon made with new patented gasoline Vaporizer. Write for particulars. Vaporizer Company, Pukwana, South Dakota.

\$15.00 DAILY selling the New Amberoid Unbreakable Combs; kind you can hit with a hammer; write for wholesale price. J. Bucknam, Box 2792, Boston, Massachusetts.

MAKE \$100 weekly selling Rolly's Washday Wonder. New chemical dirt solvent. Harmless. Cleans without rubbing. Want Agents and crew Managers. Free samples and particulars. Rolly Chemical Co., K8, Hastings, Nebraska.

MAKE \$25 to \$50 week representing Clow's Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clow Company, Desk 24, Philadelphia, Pennsylvania.

GET our plan for monogramming automobiles, trucks, hand luggage and all similar articles by transfer method; experience unnecessary; exceptional profits. Motorists' Accessories Company, Mansfield, Ohio.

AGENTS and portrait men. Crew Managers. We give you more for your money. Better and quicker service. Lowest prices on frames and glass. Rejects credited. Catalog free. The Pioneer Corporation, 1263A West 63rd Street, Chicago.

GALLAHER made \$336.00 one week selling guarantee! Collection Systems used by all business men. Sayers Mfg., 2831 Sheffield, Chicago.

SOAP agents; big profits. Sample FREE. Besteever Products Co., 1941-T12 Irving Park, Chicago.

SELL Minitmend for tires and tubes—cost 2c. Repair; surpasses vulcanizing, saves 500%. Every auto and accessory dealer buys. Profits amazing. Shaw made \$21 first day. Hart \$155 first week. Particulars and free sample. The Continental Rubber Co., Dept. 88, Philadelphia, Pa.

WORLD'S fastest selling auto accessory! County distributors wanted; write to-day. G. L. W., Spring Oiler Co., San Diego, California.

SALESMEN—Earn \$3,500 to \$10,000 a year. City or traveling. Experience unnecessary. Quickly qualify through our amazing system. Free employment service to members. Send for salesmanship book, list of lines and full particulars. National Salesmen's Training Association, Dept. 126W, Chicago, Illinois.

AGENTS: Sell rich looking 36x68 imported rugs, \$1.00 each. Carter, Tenn., sold 115 in 4 days; profit, \$57. You can do same. Write for sample offer and selling plan; exclusive territory. Sample rug by parcel post prepaid \$1.39. E. Condon, Importer, 12 Pearl Street, Boston, Massachusetts.

KEROSENE Burners for Furnaces, Cook and Heating Stoves. Economy Mfg. Company, 616 West Monroe, Chicago.

AGENTS, \$60 to \$200 a week. Free samples. Gold Sign Letters for Store and Office Windows. Anyone can do it. Big demand. Liberal offer to general agents. Metallic Letter Co., 431A N. Clark Street, Chicago.

AGENTS! 1921's Greatest Sensation. 11 piece toilet article set selling like blazes at \$1.75 with \$1.00 dressmaker's shears free to each customer. Get lined up for Christmas rush. E. M. Davis Co., Dept. 57, Chicago.

BIG profits easy. Duplex Transformers needed on every auto. Save gas. Easily sold. Exclusive distributors wanted. Jubilee Mfg. Co., 14 Sta. C, Omaha, Nebraska.

\$10 WORTH of finest toilet soaps, perfumes, toilet waters, spices, etc., absolutely free to agents on our refund plan. Lacassian Co., Dept. 615, St. Louis, Missouri.

EVERY man needs it. Every man you sell starts an endless chain of boosters. Send twelve cents for samples of new back collar button, retailing ten and twenty-five cents. Money back guarantee. Puritan Mfg. Co., 215 Fifty Associates Building, Toledo, Ohio.

SENSATIONAL—Opportunity. One sale a day means \$200 per month! Five sales, \$1,000 per month! Marvelous new adding machine. Retails \$15. Work equals \$350 machine. Adds, subtracts, multiplies, divides, automatically. Lightning speed. Errors impossible. Five-year guarantee. Used by U. S. Government and largest corporations. Tremendous demand everywhere. Amazing profits. Write quick for trial offer and protected territory. The Lightning Calculator Company, Dept. O, Grand Rapids, Michigan.

EARN \$2.00 an hour in your spare time taking subscriptions for this magazine. Write to-day for the agency in your town. Popular Science Monthly, 225 West 39th Street, New York.

EASY, pleasant work for mechanics, shop men, clerks, during spare hours, will add many dollars to their salaries. Also want persons who can give full time. Big wages assured. Novelty Cutlery Company, 27 Bar Street, Canton, Ohio.

AGENTS—Best seller: Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold, it Vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

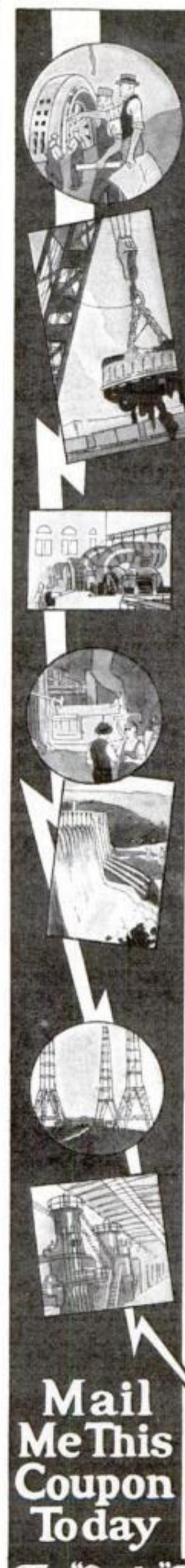
AGENTS for to-day's best selling accessory. Nifty leaf spring oilers, oils your springs, stops squeaks and breaks; makes Ford ride easy. 100% profit. Sample Ford set of four for \$1.50 and agents' proposition. Springcup Co., Schmidt Bldg., St. Joseph, Missouri.

LARGE profit on small investment. Lettering by Transfer Method. Auto Monogram Supply Co., Green Street, Newark, New Jersey.

STOP Making the Other Fellow Rich! Manufacture and sell these goods yourself from Miller's Guaranteed Manufacturer's Formulas. Enormous profits—Investment small—Business quickly established. Stamp brings detailed descriptive literature regarding Magic Windshield Cloths; Amazon Rubber Repair, Launderite Stoveoil, Fluing Paddles, Mexican Yucca Soap, Food, Automobile Household Specialties in all lines, and other valuable literature. Miller Industrial Chemist (Old Reliable Established 1897), Tampa, Florida.

AGENTS—Steady Income. Large manufacturer of Handkerchiefs and Dress Goods, etc., wishes representative in each locality. Factory to consumer. Big profits, honest goods. Whole or spare time. Credit given. Send for particulars. Freeport Mfg. Co., 24 Main St., Brooklyn, N. Y.

AGENTS—200% profit. Wonderful little article; something new; sells like wildfire; carry in pocket; write at once for Free Sample. Albert Mills, General Manager, 5183 American Building, Cincinnati, Ohio.



Mail
Me This
Coupon
Today

The "Cooke" Trained Man is the "Big Pay" Man

Be An "Electrical Expert"

L. L. Cooke
Chief Engineer
Chicago Engineering Works



ELECTRIFICATION is sweeping the country. In homes, factories, shops, farms, railroads—everywhere—it is fast becoming the one great source of power. Ten years from now practically everything now driven by steam, horse or water power will be controlled by electricity.

This means that the greatest opportunity of your life is staring you square in the face. Men are needed, badly needed, right now—*many more* will be needed almost immediately to boss the big Electrical jobs that are projected. The men who boss these jobs are going to draw real pay—"Big Pay." But they will be trained men—"Electrical Experts" who know electricity from the ground up.

Don't let this great opportunity slip. Decide today to fit yourself as an Electrical Expert, ready to take your place in this Big-Pay field, ready to

Earn \$12 to \$30 a Day

That's the kind of pay you want to see bulging *your* pay envelope. And you can! Why should you plod through life in a long-hour-small-pay, no future job, when you can *jump* to success and big-pay in Electricity?

A few short months training under me, through my easily-learned, quickly grasped, sparetime, home study course in Practical Electricity and you too can step into a big-pay job in this fascinating field.

I Back You— Guarantee Your Success

As Chief Engineer of the Chicago Engineering Works, a million dollar institution, I know exactly the training you need to succeed as an "Electrical Expert." My course in Electricity is simple, thorough and complete—no big words, no useless theory, no higher mathematics—just plain everyday, straight-from-the-shoulder English. I know that you can learn Electricity under me, in fact, I guarantee it, for if you are not entirely satisfied, I will return every cent paid me. There's no chance for failure with me.

Free Electrical Working Outfit

To make your success still more certain I give you tools to work with—a splendid big outfit of tools, materials, instruments and supplies—real apparatus with which you can do practical work.

Save \$45.50— Enroll Now

By enrolling now you can save \$45.50 on the already low price of my course. But you must act at once. Write to-day for full particulars and my big *FREE* book "How To Become An Electrical Expert." It's the first step towards bigger pay.

L. L. COOKE, CHIEF ENGINEER
CHICAGO ENGINEERING WORKS
INCORPORATED

Dept. 3y

1918 Sunnyside Ave., Chicago, Ill.

L. L. COOKE, Chief Engineer,
Chicago Engineering Works,
Dept. 3y, 1918 Sunnyside Ave., Chicago, Ill.

Dear Sir: Send at once Sample Lessons, your Big Book, and full particulars of your Free Outfit and Home Study Course—all fully prepaid, without obligation on my part.

Name.....

Address.....

115 A

Wanted! Men to Fill These \$5,000-a-Year Positions

A Great New Field as Yet Unthought of by Most Men

BOUNDLESS opportunities lie before the men who are willing to qualify for positions paying from \$2,500 to \$5,000 a year and more in this new profession. It seems incredible to the average man that thousands of splendid jobs are actually going begging for lack of men to fill them.

Transportation is to-day the second largest and most important industry in the country. Freight charges amount to a million dollars an hour—over four billion dollars a year! Yet it is estimated that eight out of every ten shippers are losing money. Thousands of dollars are lost daily because few men actually know the most economical methods of shipping.

The Traffic Profession—only about ten years old—was created when the Government passed an amendment to the Interstate Commerce Law. This made it necessary for about 1,000 railroads—60,000 large business concerns, nearly 450,000 smaller shippers—thousands of Chambers of Commerce and Commercial Clubs, State Railway Commissions, and the Interstate Commerce Commission to employ men with a technical knowledge of Traffic Management.

A Need for Trained Men That Has Never Been Satisfied Right now 100,000 trained traffic men are urgently needed. Every large concern must maintain a traffic department—employing scores of men.

A Boston concern employed a competent traffic man who saved \$9,751 in two weeks. Another traffic expert compelled an Eastern Railroad to refund \$122,000 to the Meeker Coal Company. A New York Traffic Man saved his company \$24,000 in one year.

Is it any wonder that firms are glad to pay large salaries for skilled traffic men? A Detroit Traffic Manager receives \$19,500 a year. A Cleveland man gets \$24,000. Thousands of good traffic jobs pay from \$2,500 to \$5,000 and \$10,000 a year.



The trained expert in this new profession plays a most important part in his firm's business.

An Amazingly Easy Way to Train for a Big Job

Until a short time ago, there was no simple way for the average man to become a Traffic Manager. But now the American Commerce Association, a national organization of Traffic Men, offers to prepare men to handle the problems of shipping. It has already helped hundreds to big positions as Traffic Managers.

This training is given during spare time, at home. Once a member of this great association, you receive the help of its Advisory Traffic Council, made up of traffic men of national reputation.

An Interesting Book Free for the Asking To give the whole story the Association has prepared a remarkable book, "Opportunities and Requirements for Traffic Work." This book explains how anyone can quickly qualify for the important job of Traffic Manager. It cites many stories of success by members of the Association. After reading it, you will understand why \$5,000 salaries are common and why thousands of jobs pay \$2,500 to \$10,000 a year and more. Write to-day for this wonderful book—no cost or obligation—just mail coupon below. Address: American Commerce Association, Dept. 1412, 4043 Drexel Blvd., Chicago, Ill.

**American Commerce Association, Dept. 1412
4043 Drexel Boulevard, Chicago, Ill.**

Please send your new free book on "Opportunities and Requirements for Traffic Work" without obligation to me. I have had previous traffic experience.....no traffic experience.....

Name.....

Address.....

Age..... Occupation.....

Can You Manage Production?

Production must be *managed*. Men, material, equipment must be understood and directed by *trained men*.

As industry launches itself upon a great drive against waste, the doors of the nation's 300,000 producing plants are open to the Industrial Engineer today as never before.

Industrial Engineering

is being taught according to the university plan to thousands of men who are destined to fill the big, executive, managing jobs in industrial organizations. Many of them have already increased their salaries from 200% to 400%, all the way from \$2,000 to \$25,000 per year men.

No man with industrial inclinations has a right to expect a greater opportunity. Get the whole interesting story with the coupon below.

Industrial Extension Institute
9 West 45th Street, New York City

Name.....
Address.....
(Pop. Sci. Mo., Dec., 1921)

National College of Chiropractic

Catalogue on Request

RESIDENTIAL

16 N. Ashland Blvd. Chicago

Unsurpassed facilities for a complete Scientific Chiropractic education. Distinguished Faculty. Modern and extensive laboratory equipment. Large clinic. Gymnasium dormitory and students' aid dept. Chicago's opportunity for self help unlimited. Enter quarterly. 3-year term. 14th Year.



This Man Earns \$83 a Day

His name is J. F. James. He left school when he was a boy. He was down, but he refused to stay down. He worked! He studied! And today he is president of the Mascot Stove Company, of Chattanooga, Tenn., at a salary of \$25,000 a year! He says that the I. C. S. "made his success possible."

Won't you let the I. C. S. help you, too? When everything has been made so easy—when so many other men are going forward to success—can you afford to let another priceless hour go to waste?

The way is easy. Without obligation or a penny of cost, mark and mail the coupon today and let us tell you how you, too, can win advancement and more money through spare-time study at home with the I. C. S.

— TEAR OUT HERE —

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 7649-B Scranton, Pa.

Explain fully about your Course in the subject marked X

- | | | |
|------------------------|------------------|---------------|
| DRAFTING | Electrical Eng'g | Advertising |
| Mechanical Engineering | Stationery | Salesmanship |
| Surveying | CHEMISTRY | Bookkeeping |
| Civil Engineering | AUTOMOBILES | Civil Service |
| ARCHITECTURE | STENOGRAPHY | Mail Services |

Name.....
Street.....
Address.....
City..... State.....

DISTRICT Managers wanted for tremendously successful new office specialty. Two minute demonstration means sale. Wonderful repeater. Gold mine for you. Perfection Mfg., 123 So. Fourth, Philadelphia, Pennsylvania.

SELL necessities. Everybody needs and buys the "Business Guide." Bryant cleared \$800 in July. Send for sample. It's free. Nichols Company, Box 1B, Naperville, Illinois.

WOLVERINE cloth polishes all metals. Sample and particulars free. Manufacturer, 404-E, Sun Building, Detroit, Michigan.

OFFICE Necessity. Costs 25c, sells \$1.00. Big repeater. Agents coining money. Acidproof Ink Co., Philadelphia, Pennsylvania.

CAPITALIZE your spare time easily and pleasantly. Make \$10.00 where you now make \$1.00. No experience nor capital necessary. Stacey, 4020 Crutcher Street, Dallas, Texas.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

TOWLINES. Small. Guaranteed. See advertisement under AUTOMOBILES ACCESSORIES. Superior Manufacturing Company.

AGENTS—A new invention. Harper's fibre broom and ten-use brush set. It sweeps, washes and dries upstairs windows, scrubs porch ceilings and does seven other things. Big profits; easy seller. Free trial offer. Harper Brush Works, Dept. G, Fairfield, Iowa.

MAKE 600% profit. Free samples. Lowest priced gold window letters for stores, offices. Anybody can do it. Large demand. Exclusive territory. Big future. Side line. Acme Letter Company, 2800 N. Congress, Chicago.

17 CENTS profit on every 25-cent sale means big daily profits. Box 500, Shreveport, La.

FREE Sample. "Rain Shield Wiper." Every Autoist buys quickly. Retail \$1.00—Costs you 25 cents—(300% Profit). No mechanical attachment—no cloth. One rub keeps windshield clear 24 hours against rain, snow storm. Wonderful side line—carried in pocket. Only 1 free sample given away in your town. Hurry, write for yours. NuLife Auto (M) Aid Corporation, Hartford, Connecticut.

COIN money selling Neverwet Shoulder Strap Water proof Aprons. Every woman buys. Best on market. We manufacture and ship direct. Get details to-day. A. E. Bergen Manufacturing Company, 413 Locust Street, Philadelphia.

AGENTS coining money selling Universal Gas Savers for every gas stove. Wonderful device. Cuts gas bills in half. Increases heat. Popular prices. 100% Profit. Exclusive territory. Write quick. B. D. Moore, Gas Saver Company, Topeka, Kansas.

EVERYBODY eats every day—You can handle Sugar, Flour, Canned Goods, Dried Fruit, Coffee and entire line of groceries, as well as Paints, Roofing, Aluminum Ware and Automobile Oils, with no rent to pay; no money invested; take large orders from samples. Goods are guaranteed and proven quality. Selling experience not necessary. Steady, profitable work for "workers." Address, Hitchcock-Hill Co., Dept. 220, Chicago, Ill. Reference: Any Bank or Express Co.

AGENTS Wanted—Something New—Fire Fighter sells easily. Makes a spectacular demonstration; car owners, homes, factories, stores, practically buy on sight. Our men make \$10.00 to \$50.00 a day; exclusive territory. If you wish to establish a business of your own with unlimited possibilities for making big money, write us today. Fyr-Fyer Co., 109 Fyr-Fyer Bldg., Dayton, Ohio.

We want men and women who are desirous of making \$25.00 to \$200.00 per week clear profit from the start in a permanent business of their own. Mitchell's Magic Marvel Washing Compound washes clothes spotlessly clean in ten to fifteen minutes. One hundred other uses in every home. Nothing else like it. Nature's mightiest cleanser. Contains no lye, lime, acid or wax. Fastest selling article ever sold through agents. Free samples make sales easy. Enormous repeat orders. 300% profit. Exclusive territory. We guarantee sale of every package. No capital or experience required. Baker, Ohio, made \$600 last month. You can do as well. Send for Free sample and proof. L. Mitchell & Co., Desk 301, 1308-1314 E. 61st, Chicago, Illinois.

A Good Seller. A decent income. Precision Co., Queens, New York.

CALIFORNIA Buckskin Mending Tissue repairs clothing without thread. Recommended by housewives everywhere. Splendid sideline. Attractive proposition and sample free. Norman Ovri, East San Diego, California.

AGENTS simply coin money with newest, greatest household article ever put out. Every woman wants this article as soon as she sees it. Every home a prospect for one to a dozen. Saves food—saves time—saves money. Forty per cent commission on all sales. Be first in your territory. Make big money. Write now for full particulars. The Aridor Company, 586 E. Illinois Street, Chicago, Illinois.

HIGH class specialty salesmen covering one or more States with spare time to interview other salesmen. Big money with us. Credentials or no answers. Confidential. Rickey Co., 6157 Wentworth, Chicago.

MAKE Money at home making toys—we show you how. Send 50c (no stamps) for complete working drawings and instructions. Dekalb Designing Co., Decatur, Georgia.

FREE Sample of quick selling patented specialty. Live Wire salesmen, get yours now. Also details of wonderful \$5,000-year opportunity. Agents wanted everywhere. H. G. Martin, 51 Cliff St., New York.

AGENTS: If you are making less than \$300 a month, our proposition on Sentinel Burglar Alarms for windows and doors will interest you. Many agents earn \$20 daily. Brand new inventions. No wires or batteries. Instantly attached to any door or window. No competition. Provides cheap burglar insurance. Big money makers. Write to-day for extremely liberal terms to agents. Sentinel Alarm Co., 1452 Marquette Bldg., Chicago, Illinois.

SELL Food Products. Everybody has to eat. Strictly high grade, pre-war prices. Steady work—good profit. Sample Free. Consumers Supply Company, 601 Consumers Bldg., Portland, Michigan.

MILLER made \$225 one week selling Guaranteed Business Producer. Double Display metal changeable letter sign for stores, worth \$5, sells \$3, sample \$1.50 postpaid. Write Currier Mfg. Co., Minneapolis, Minnesota.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

AGENTS: Everybody uses extracts. Sell Duo Double Strength Extracts and complete line Household Necessities. Products used constantly. Big repeaters. Write today. DUO Co., Dept. E66, Attica, New York.

SALES District Managers wanted for Dominant Polish, the new wonder that is being adopted everywhere. If you have small capital, we can make you a remarkable offer, one that will put dollars in your pockets while you are making cents now. Exclusive Territory granted. Dominant Products Co., 163 South Street, New York City.

AGENTS—Clever Invention! Inkspoon makes every pen a fountain pen. Fast office seller; big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Muri Company, Tribune Building, New York.

ATTRACTIVE openings for men and women who have time to build up a permanent and lucrative business of their own. No experience necessary. Sell protection against death and loss of income from accident and sickness, \$7,500 death benefit, \$25.00 weekly, costs \$10.00 yearly. Other amounts in proportion. Guaranteed income from renewal commissions. Easily sold, all occupations insurable at one rate, no confusing classifications. Over \$1,000,000.00 Resources, established 1886. North American Co., 308 Walnut St., Philadelphia.

AGENTS: We pay \$6 a day taking orders for New Kerosene Burner. Fits any stove, burns coal oil. No experience or capital required. Work spare time or full time. Write for demonstrating sample. Thomas Mfg. Co., Class 2661, Dayton, Ohio.

100% PROFIT selling Three-in-One Holder. New patented, small, universally useful article. Very fast seller. Ribbon Steel Products Corporation, 1211 Engineering Building, New York.

BE independent. Work for yourself. Sell auto specialties. Make real money. Particulars free. Fadenrecht's Chemical Works, Corn, Oklahoma.

MONEYMAKING Books, Plans, Formulas, Catalogs Free. Ideal Book Shop, 5501-P, North Robey, Chicago.

SEND for free sample Fretnot Washday Wonder. Be convinced you can do a whirlwind business. Constant repeater with large profits. You take no chance. We positively guarantee sale. P. S. Motter & Sons, 20 E. Jackson Boulevard, Chicago.

POIMET Polishing Cloth cleans all metals. Retails 25c. Sample free. F. C. Gale, 15 Edinboro Street, Boston.

GENUINE Buckskin Gloves direct from factory, \$3.95. Made from selected skins. Agents wanted. Qualie-Angus Co., Desk (36), Gloversville, New York.

PREPARE and Market Your Own Products—Master formulas; manufacturing processes; trade secrets; commercial information. Particulars free. The Thaxby Co., Dept. 11, Washington, D. C.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

HELP WANTED

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Slann Sign System, 7505 St. Antoine, Detroit, Michigan.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports. Salaries, expense. American Foreign Detective Agency, 321, St. Louis.

SILVERING mirrors, French plate taught. Easy to learn, immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Missouri.

MEN wanted to make Secret Investigations and reports. Experience unnecessary. Write J. Ganor, Former Gov't Detective, 115, St. Louis.

WRITE Photoplays: \$50 each. Experience unnecessary; details free to beginners. Producers' League, 194, St. Louis.

\$135 Month. Railway Mail Clerks. Hundreds wanted. Steady. List positions free. Write immediately. Franklin Institute, Dept. 842, Rochester, New York.

BIG Money Made Silvering Mirrors, metal plating, refinishing. Outfits furnished. F. Decie Laboratories, 286 Fifth Avenue, New York.

DETECTIVES earn Big Money. Excellent opportunity. Travel. Fascinating work. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, New York.

GOVERNMENT Clerks Needed Soon (men—women), \$1600-\$2300. No experience required. Write Mr. Ozment, former U. S. Government Examiner, 295 St. Louis, Mo.

MEN to represent corporation by interviewing business men at home or travelling. Nothing to sell. Equipment furnished you free. Earnings from \$2000 to \$9000 yearly. Popular 3509 White Plains Ave., New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

BE a Mirror Expert. \$3-\$10 a day; spare time at home first; no capital; we train, start you making and silvering mirrors. French method. Free prospectus. W. F. Derr, Pres., 579 Decatur Street, New York.

BE a Railway Traffic Inspector! \$110 to \$250 monthly, expenses paid, after 3 months' spare-time study. Splendid opportunities. Position guaranteed or money refunded. Write for Free Booklet Cm-13. Standard Business Training Institute, Buffalo, New York.

FIREMEN, brakemen, baggage men, \$140-\$200. Colored porters by railroads everywhere. Experience unnecessary. SJS Ry. Bureau, East St. Louis, Illinois.

STOP daily grind. Start silvering mirrors, auto head-lights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 95, Marion, Indiana.

HAVING sold 150,000 of a household appliance in New England we are ready to make general offer whereby direct salesmen are now averaging \$45 weekly. No capital required. Unique method of obtaining interviews. Opportunity for District Management. The Reeves Company, 53 Broad Street, Milford, Connecticut.

WANTED: Representatives to handle household necessities. Grand opportunity to work way through Elms Commercial College. Students Aid Sales Department, Newark, New York.

BUILD a Sign Business. Experience unnecessary. Send \$1.00 for sample sign, your name embossed, information. Impres Sign Company, 202-B, District National Bank, Washington, D. C.

Become a Motor Expert

Learn Autos in Washington
Earn BIG Money as an Auto,
Truck, Tractor or Airplane Mechanic

Trained mechanics earn \$150 to \$400 a month and many are earning \$5,000 to \$10,000 and MORE a year in THEIR OWN BUSINESS. We fit you in our New school to MAKE REAL MONEY in 6 to 8 weeks.

FREE Catalog and Book of Views of Washington

cutting, forging; in fact, we teach you ALL that you MUST know if you are to be rated as a first-class auto mechanic.

SPECIAL LIMITED TIME Tuition Rate

EARN
\$150 to
\$400
a Month.

To quickly enroll one thousand students we have made a very LIBERAL REDUCTION from our regular rate. We reserve the right to withdraw this offer at any time.

HERE is YOUR OPPORTUNITY to learn to be an auto mechanic and visit and see Washington at the same time and at a very low cost. Decide to make the trip that you have always wanted to make and to learn the trade that you have always wanted to learn. Train for independence, prosperity and success NOW. Come to Washington.

FREE New Catalog and Book of Views of Washington

Before you decide on ANY school ANYWHERE BE SURE TO READ OUR CATALOG. It contains just the information you MUST have before you can decide fairly for your own best future.

MAIL THIS COUPON TODAY

American Motor School, Inc., Dept. 212
1612-1622 U St., N. W.
Washington, D. C.

Without cost or obligation,
please send your catalog and
"Washington Views."

Name.....

Address.....

City..... State..... Age.....

DO YOU LIKE TO DRAW?

Cartoonists are well paid

We will not give you any grand prize if you answer this ad. Nor will we claim to make you rich in a week. But if you are anxious to develop your talent with a successful cartoonist, so you can make money, send a copy of this picture, with 6 cents in stamps for portfolio of cartoons and sample lesson plate, and let us explain.

The W. L. EVANS SCHOOL OF CARTOONING
825 Leader Bldg., Cleveland, Ohio



HEAVEN and HELL

By Emanuel Swedenborg

This book of 632 pages, or any of the following works of Swedenborg, printed in large type on good paper, well bound in stiff paper covers, will be sent, prepaid, on receipt of 15 cents per book:

Divine Providence - - 629 pages
The Four Doctrines - - 635 pages
Divine Love and Wisdom, 618 pages

The American Swedenborg Printing and Publishing Society
Room 754 3 W. 29th STREET New York

LEARN ELECTRICITY IN 3 MONTHS

Intensive, individual and practical instruction in America's greatest and best equipped trade school. Master Craftsmen always at your side to guide you.

ELECTRICAL EXPERTS EARN BIG PAY
Big demand for trained electricians now. Come to the COYNE SCHOOL while learning. Free Employment Department Service, Free Automotive Electrical Course and Complete Course in Business Management to students enrolling now in our Complete Electrical Course. No extra cost; no extra fees. Chicago offers you a wonderful opportunity for recreation and study. Send for Coyne's Book of Opportunity now. You can get into the Big Pay Class if you start at once.

Coyne
Trade and Engineering Schools
39-51 E. Illinois St., Chicago, Ill.
Dept. 3Y

GOVERNMENT needs Railway Mail Clerks, \$133 to \$192 month. Write for free specimen questions, Columbus Institute, Columbus, Ohio.

WANTED Men to prepare for positions as Mechanical Draftsmen under personal supervision of Chief Engineer, Box 45, So. Gardner, Mass.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising Popular Science Monthly, 225 West 39th Street, New York

Trained Minds Win What Chance Has Yours?

1 Chance for Success

9 Chances for Success

238 Chances for Success

Thus does a great newspaper editorially on a recent report on industrial education made to the American Society of Mechanical Engineers.

Think what these figures mean! With only an elementary education, you have just one chance in 41,250 to achieve success. A high school education increases your chance nine times. With a college education, or its equivalent, you multiply your chance by 238.

Only a few men out of every thousand can go to college or to a good technical school. The great majority must find some other way of getting a special education.

The United Y. M. C. A. Schools furnish one reliable way of doing this through the use of *spare hours without giving up present employment*. Thousands of superintendents, foremen, department managers, engineers, accountants, salesmen, business executives, etc., owe their positions to spare-hour study under Y. M. C. A. direction.

In the 240 United Y. M. C. A. Spare-Hour Courses there is one to fit your need. United Y. M. C. A. correspondence instruction gives you: (1) the most service for the least money; (2) careful guidance in selecting a course; (3) the personal, sympathetic attention of an earnest instructor, and (4) as much encouragement to complete your course as to begin it.

During the last twelve months more than 140,000 ambitious young men have enrolled with the United Y. M. C. A. Schools. Advance with them! Don't drudge along in poorly paid or distasteful work when the world is demanding trained heads, men able to take positions as leaders, who can create, execute and direct.



From
New
York
Times
Aug. 30th
1921

Multiply Your Chances Of Getting Ahead

Send this inquiry coupon. You will receive interesting details of the course of your choice, also a free copy of our new booklet "Does Education Pay?"

UNITED Y. M. C. A. SCHOOLS, Dept. 8-D, 375 Lexington Ave., New York City

I am interested in the position or home-study course I have marked. Please give full information.

- | | | |
|------------------------|----------------------|------------------------|
| —Accountant | —Civil Service | —Illustrator |
| —Advertising Man | —Commercial Spanish | —Locomotive Operation |
| —Agricultural Courses | —Concrete Engineer | —Machine-Shop Practice |
| —Applied Psychology | —Dairy Farming | —Mathematical Courses |
| —Architect | —Draftsman | —Mechanical Engineer |
| —Auto Mechanic | —Electrician | —Plumber |
| —Banking | —Electrical Engineer | —Poultry Husbandry |
| —Better Letters | —English Courses | —Radio Operator |
| —Bookkeeper | —Factory Management | —Radio Engineer |
| —Building Construction | —Farm Management | —Railroad Engineering |
| —Business English | —Farm Motor Mechanic | —Salesman |
| —Business Law | —Foreign Languages | —Secretarial |
| —Business Organization | —Foremanship | —Steam Engineer |
| —Chemistry | —Freehand Drawing | —Stenographer |
| —Civil Engineer | —Highway Engineering | —Structural Drafting |

Name and
Occupation . . .

(Please Write Plainly)

Complete Address . . .



HIGHER EDUCATION

HOME
STUDY

Courses in English, Spanish, Mathematics, Chemistry, Drawing, Education, Business and in 35 other subjects are given by correspondence. Begin any time.

The University of Chicago

Division 35, Chicago, Ill.

WANTED! RAILWAY MAIL CLERKS

Examinations soon. \$1600 to \$2300 a year. Steady life-time job. Common education sufficient. No "pull" necessary. Mail coupon for Catalog.

Patterson Civil Service School,
Dept. 1612, Rochester, N. Y.

Sirs: Send me without charge your Catalog, describing this and other fine U. S. Government positions.

Name . . .

Address . . .

Popular Handbook for Cement and Concrete Users

A book of value to the concrete user, including kinds of cement employed in, construction, concrete architecture, inspection and testing, waterproofing, coloring and painting, rules, tables, working and cost data.

430 pages, 126 illus. Price, \$3.00

POPULAR SCIENCE MONTHLY, 225 W. 39th St., New York

Our Scientific Method will stop that STAMMER!

Send for free 200 page book. It tells how to permanently stop stammering or stuttering in a few weeks' time. A natural guaranteed method.

The Lewis School for Stammerers
56 Lewis Bldg., 71-77 Adelaide St., Detroit, Mich.

CARPENTERS, Bricklayers, Mechanics, Electricians, Plumbers, Pipefitters, Boilermakers, Sheet Metal, Shipyard, Concrete, Structural Workers and others can you read Blue Prints? If not learn how. It will help you hold your job. It will get you a better job. It will earn you more money. Write for Catalog B, stating trade.

We also teach drafting. Be a Draftsman. Earn big money. We train you quickly. Books and tools FREE. Write for Catalog G.

Columbia Correspondence School Est. 1904

Dept. 27, Drexel Bldg., Phila., Pa.

Quick-Action Advertisements continued on page 19

NICKEL Plate automobile accessories, hardware, electrical parts. Big profits. Requires no capital. Simple battery process. Write to-day. Webster Engineering Co., Webster Groves, Missouri.

I MADE \$30 a week home. French bread-making. 15 years' experience. Free booklet tells. Ashbrook, E. 67, Marengo, Ohio.

LET'S swap! Buy! Sell! What'd ye got? What'd ye want? Dime brings results! Swap Bulletin, 1833 Bathgate Ave., Bronx.

START a business in your kitchen. Write Chas. Mitchell, 1402 Winnemac, Chicago.

AN attractive proposition is offered persons desiring a better future. The Aetna Company, 2407 College Ave., Philadelphia, Pa.

TO Amateurs in Towns of 100,000 or less: Listen—Are you interested in making money in your spare time? Write us, telling your age and standing with your local radio field. The information you furnish us will determine whether you are qualified to receive an interesting and reasonable proposition from us. Address Radio Dept. Federal Telephone & Telegraph Co., Buffalo, New York.

STAMPS AND COINS

LIKE Triangular Stamps? To introduce our Sudden Service Approvals we'll send triangular Flume, set China ships, large \$1.00 United States revenue, also packet 50 foreign, millimeter scale, perforation gauge, ruler and bargain lists—for only 9c. Fennell Stamp Company, Department C, Fullerton Building, St. Louis, Missouri.

CALIFORNIA gold \$1/4 size, 27c; \$1/4 size 53c. White cent and Catalogue, 10c. Normal Shultz, Colorado Springs, Colorado.

1000 different stamps, \$3.00; 500, \$1.25; 200, 20c; 100, 12c. Approvals. Michaels, 5602 Prairie, Chicago.

CALIFORNIA Gold, quarter size and German 5pf 30c; Villa coin and catalog 10c. Homer Shultz, Union Star, Missouri.

158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc., only 10c. Finest Approval Sheets 50% to 60%. Agents wanted. Big 72-p. Lists Free. We buy stamps. Established 25 years. Huseman Stamp Company, Dept. 55, St. Louis, Missouri.

STAMPS—500 different, \$1.25; 300, 70 cents; 200, 25 cents; 100, 10 cents. List free. Approvals, for reference. Elwood D. Weber, 812 South Avenue, Plainfield, N. J.

STAMPS, 20 unused. All Different, 3 cents. Mention paper. Quaker Stamp Co., Toledo, Ohio.

STAMPS—50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., and Album 10c. 50 different U. S. 25c. 1,000 hinges, 10c. 1,000 mixed, 40c. List free. I buy stamps. C. Stegman, 5949 Cote Brillante, St. Louis, Missouri.

FRENCH Colonials, 25 different, only 10c. Nickles, 122 Florida Avenue, Washington, D. C.

55 ALL DIFFERENT stamps, including China, Japan, French Colonies, etc., given to applicants for our high grade approval selections. Send references and 2c stamp to the Edgewood Stamp Company, Dept. M., Millford, Connecticut.

OLD coins, large Fall selling catalogue of coins for sale, free. Catalogue quoting prices paid for coins, ten cents. William Hesslein, 101A Tremont Street, Boston, Massachusetts.

17 VARIETIES Bulgaria stamps, 20 cents. List of 7,000 low-priced stamps free. Chambers Stamp Company, 111C Nassau Street, New York City.

TURKEY. 54 varieties, \$1.00. Mouhib, 608 West 125th Street, New York.

STAMPS—50 different Jamaica, Venezuela, etc., only 10c; 100 all different, 13c; 1000 all different, \$4.52; 10 different, United States, 25c; 1000 hinges, 10c; 50% approvals with every order. List free. I buy stamps. L. B. Dover, Longmont, Colorado.

50 DIFFERENT Portuguese Colonies 40c. Browne, 11 Willow, Wollaston, Massachusetts.

25 Newfoundland, etc. Two cents. Harland Burgett Co., Lima, Ohio.

REPUBLIC of France—65 different for 25c. Jacob Fischer, 1539 North Lawler, Chicago.

APPROVALS and packets. G. E. Labrie, 3254 Marshall Way, Sacramento, California.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., for October 1, 1921. State of New York, County of New York, ss. Before me, a notary public, in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Modern Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Editor, Kenneth W. Payne, 225 West Thirty-ninth Street, New York, N. Y. Managing Editor, Kenneth W. Payne, 225 West Thirty-ninth Street, New York, N. Y. Business Manager, O. B. Capen, 225 West Thirty-ninth Street, New York, N. Y. 2. That the owners are: The Popular Science Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 225 West Thirty-ninth Street, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; Waldemar Kaempfert, 680 Fifth Avenue, New York, N. Y.; George B. Agnew, 22 William Street, New York, N. Y.; Susan D. Bliss, 22 William Street, New York, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: O. J. Ridenour, New York, N. Y.; Samuel Insul, Chicago, Ill. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) O. B. CAPEN, Business Manager.

Swear to and subscribed before me this 7th day of October, 1921.

Arthur A. Blauvelt, Queens County—1260, New York County—101, New York Reg. 3090.

(Seal.) My commission expires March 30, 1923.

His New Invention Finds and Corrects Your Mistakes in English!

AS the result of thousands of tests, Sherwin Cody found that the average person is only 61% efficient in the vital points of English. In a five minutes' conversation, or in an average one page letter, from five to fifty errors will appear. It is surprising to see how many experienced stenographers fall down in spelling such common words as "business," "abbreviate," etc. It is astonishing how many business men say "between you and I" instead of "between you and me," and use "who" for "whom" and mispronounce the simplest words. Few people know whether to use one or two "c's" or "m's" or "r's," whether to spell words with "ie" or "ei" and when to use commas in order to make their meaning absolutely clear.

A Remarkable Discovery

Mr. Cody has specialized in English for the past twenty years. But instead of going along in the old way he has applied scientific principles to teaching the correct use of our language. He made tens of thousands of tests of his various devices before inventing his present method. In all his tests he found that the trouble with old methods is that points learned do not stick in the mind. In school you were asked to remember rules, and if you forgot the rules you never could tell what was right and what was wrong. For the past five years Mr. Cody has worked almost day and night to find a way to replace bad habits in writing and speech, with good ones. And as a result of his experience he evolved his wonderful new

Self-Correcting Method

Mr. Cody was granted a patent on his unique device, and now he places it at your disposal. This invention is simple, fascinating, time saving, and incomparably efficient. You do the lesson given on any page, then you see exactly how Mr. Cody himself would correct it. You mark your errors and check them in the first blank column. Next week you try that page again, on the second unmarked sheet, correct your errors, and check them in

The Boy Craftsman

Tells how to design and make many useful things. Many suggestions for indoor and outdoor pastimes. Price, postpaid, \$2.65.

Popular Science Monthly, 225 West 39th Street, New York City



Learn Style

Begin Today—Write for My FREE BOOK
I can make a good penman of you at home during spare time. Write for my FREE BOOK.
HOW TO BECOME A GOOD PENMAN. It contains exercises and tells how others mastered penmanship by the Tamblin System. Your name will be elegantly written on a card if you enclose stamp to pay postage. FREE BOOK—
Write for it Today.

F. W. Tamblin, 437 Ridge Bldg., Kansas City, U. S. A.

STAMMER

If you stammer attend no stammering school until you get my large FREE book entitled "STAMMERING, Its Origin and The Advanced Natural Method of Cure," bound in cloth and stamped in pure gold. Ask for special tuition rate and a FREE copy of "The Natural Speech Magazine." Largest, best equipped and most successful school in the world for the cure of stammering. No sing-song or time-beat. School open all year. Now is the best time to enroll. Lee Wells Millard, Pres.

The North-Western School, 2335 Grand Ave., Milwaukee, Wis.

the second column. You see at a glance what you have learned and what you have failed to remember, until you have reached the 100% point in spelling, punctuation, grammar, and expression.

Only 15 Minutes a Day

A remarkable advantage of Mr. Cody's course is the speed with which these habit-forming practice drills can be carried out. You can write the answers to fifty questions in 15 minutes, and correct your work in five minutes more. You waste no time in going over the things you already know. Your efforts are automatically concentrated on the mistakes you are in the habit of making, and through constantly being shown the right way, you soon acquire the correct habit in place of the incorrect habit. There are no rules to remember. There is no tedious copying. There is no heart-breaking drudgery.



Sherwin Cody

New Book Free

Every time you talk, every time you write, you show what you are. Your English reveals you as nothing else can. When you use the wrong word, when you mispronounce a word, when you misspell a word, when you punctuate incorrectly, when you use flat, ordinary words, you handicap yourself. If you feel your lack of Language Power, if you are ever embarrassed by mistakes, if you cannot command the exact words to express your ideas, our new booklet "How to Speak and Write Masterly English" will prove a revelation to you. Merely mail the coupon, and it will be sent by return mail. Learn how Sherwin Cody's new invention makes command of language easy to gain in 15 minutes a day.

Mail this coupon or a postal AT ONCE.
SHERWIN CODY SCHOOL OF ENGLISH
1812 Searle Building, Rochester, New York

Sherwin Cody School of English,

1812 Searle Bldg., Rochester, New York.

Please send me at once your Free Book "How to Speak and Write Masterly English."

Name _____

Address _____

City _____ State _____

Descriptive Astronomy

By E. M. Moulton. A study of the earth, sun, moon, and stars, with a simple explanation of the principles of astronomy. Price, postpaid, \$2.65.

Popular Science Monthly, 225 West 39th Street, New York City

Copy this Sketch

and let me see what you can do with it. Many cartoonists and illustrators earning \$30.00 to \$200.00 or more per week were trained by my personal individual lessons by mail.

Landon Picture Charts make original drawing easy to learn. Send sketch with 6c in stamp for sample Picture Chart, long list of successful students, and evidence of what you can accomplish. Please state age.

THE LANDON SCHOOL
451 National Bldg., Cleveland, O.



FREE BOOK



Learn Piano!

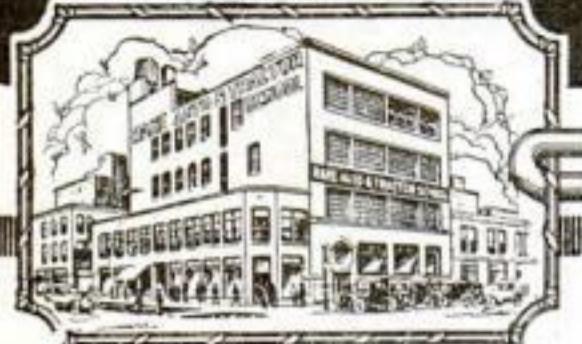
This Interesting Free Book

shows how you can become a skilled player of piano or organ in your own home, at one quarter usual cost. Dr. Quinn's famous Written Method is endorsed by leading musicians and heads of State Conservatories. Successful 26 years. Play chords at once and complete piece in every key, within 4 lessons. Scientific yet easy to understand. Fully illustrated. For beginners or teachers, old or young. All music free. Diploma granted. Write today for 64-page free book, "How to Study Music".

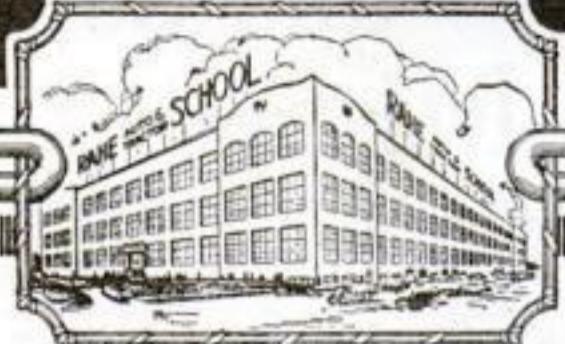
M. L. QUINN CONSERVATORY, Studio P532, 598 Columbia Road, Boston, 25 Mass

Copyrighted material

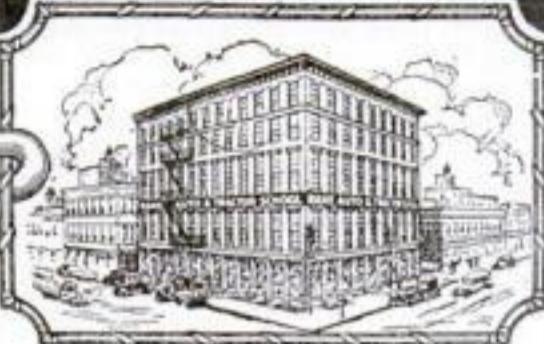
Now 3 Big Rahe Schools



Chicago, Illinois
~ MICHIGAN AVE ~ ONTARIO ST ~



Kansas City, Missouri
~ 22 NO & OAK ST ~



Cincinnati, Ohio.
~ 9TH & WALNUT ST ~



**MONEY
MONEY
more
MONEY**

Thousands of men come or write to me—

"How can I make more money? I want a better job—more pay—a bigger future."

I answer them—"Know how to do some one thing well. Be a trained man. Learn by actually doing, under competent instructors, the work you would like most to do. Become an expert in the best paying business today—the Auto Service Business."

Come to a RAHE School. Learn Auto Mechanics thoroughly. Qualify for BIG MONEY Jobs. Don't delay. Write for my 68-page catalog. Write TODAY.

I have brought the **Rahe Way** OF AUTO & TRACTOR TRAINING to YOU **OPPORTUNITY** is now hundreds of miles closer

NOW you have the choice of THREE BIG RAHE SCHOOLS. I have established the famous RAHE-WAY of Automotive Training in Chicago and Cincinnati, as well as Kansas City. To thousands of young men, OPPORTUNITY now is hundreds of miles closer—as near as Chicago or Cincinnati.

Hundreds Train at Cincinnati

For 14 years I have been teaching Auto and Tractor training at Kansas City. The great success of my school meant I must expand—add more floor space or establish new schools. Why not, I thought, take Automotive Training to the thousands of men who could not come to Kansas City? My idea proved sound. The Cincinnati School has been a big success from the day its doors were opened. From the Eastern, Southern and Central States, hundreds of students have poured into Cincinnati.

Chicago School is Popular

Now the Chicago School is going full-blast. It is a full-fledged, independent institution, teaching the famous RAHE-WAY, equalled just the same as the other RAHE Schools. Already hundreds of students are in training. Hundreds and thousands are coming. Why?

This Is An Automotive Year

More money is being spent this year than last for auto and tractor upkeep and repair. THREE BILLION DOLLARS this year to keep autos running. You can have a big part of this \$3,000,000,000.00 if you train yourself the RAHE-WAY—the Practical Job Method of teaching Automotive Mechanics. You can

Make \$150 to \$400 a Month

RAHE Graduates everywhere are making Big Money. This is YOUR opportunity to BREAK AWAY from LOW PAY. Clip out the Coupon and send it to-day. It will be one of the most fortunate things you've ever done

SEVEN DAYS' TRAINING FREE

Come seven days to a Rahe School. I guarantee that if you are not completely satisfied with the training at the end of that period—IT WON'T COST YOU ONE CENT.

SAVE \$50

Write today for my special limited time tuition offer which will save you \$50. This is a lot of money. It will—pay your room and board while here,—far more than pay your railroad fare to my nearest school. Don't delay a minute. My guarantee makes it easy for you to come now—or I am taking the chance not you. If impossible to catch the first train, write today for my 68-page catalogue, which tells how other men have found the road to big money positions, independence, success.

HENRY J. RAHE, Dept. 2880

Chicago, Illinois,
Michigan Ave. & Ontario St.

Kansas City, Mo.
22d and Oak Sts.

Cincinnati, Ohio
5th & Walnut Sts.

Mail This Coupon Now!

Send this coupon today for my fine 68-page Catalog showing graduates success and opportunities now open. (Address nearest School.)

2880



Write for
This 68-
Page
Book

Name.....

Address.....

Age..... Occupation.....

Popular Science Monthly

December, 1921; Vol. 99, No. 6
25 Cents a Copy; \$3 a Year



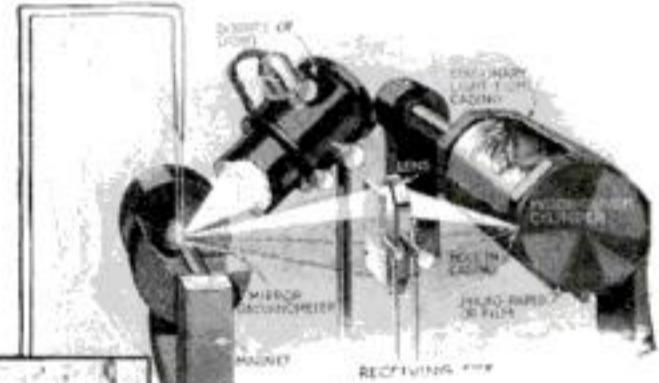
Published in New York City at
225 West Thirty-ninth Street

1916

How the World's First Wireless News-Picture Was Flashed Across the Atlantic Ocean Paris gets President Harding's portrait in twenty minutes

By Wilfred S. Ogden

LAST January Popular Science Monthly described the apparatus by which Edouard Bélin had sent photographs by telegraphy. By midsummer M. Bélin had realized improvements predicted in our first article, and was able to undertake transoceanic wireless transmission of pictures and handwriting! You are sure to find fascinating information in the following account of his new apparatus.



WHILE the crowds are still filing out from the football field, theater audiences in cities a thousand miles away are watching actual motion-pictures showing the last plays of the game!

Do you call that merely a fantastic dream?

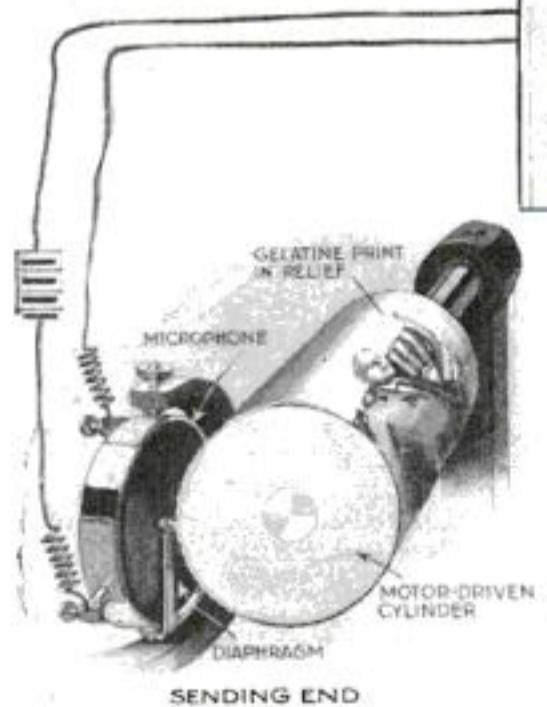
Wouldn't you also have said only a few months ago, that the scheme of flashing a man's portrait by wireless across the Atlantic Ocean was merely a fantastic dream?

Yet this amazing feat is actually one of the miracles wrought by science in 1921! A picture of President Harding in action was wireless from Annapolis to Paris in the space of twenty min-



The Miracle Picture of the Year!

Here is the first important news-picture ever to be sent by wireless. It is an action portrait of President Harding, exactly as it was received in Paris, twenty minutes after M. Edouard Bélin's radio apparatus had started sending it from Annapolis



At the left is the cylinder with the chrome-gelatine print wrapped around it. The microphone point travels over the cylinder in the same way as the reproducer on the old type phonograph

The beam of light at the receiving station is controlled by the radio impulses sent out from the transmitting station. Bélin's greatest problem was to make sure that the two cylinders located thousands of miles apart revolved at the same rate. A system of electric chronometers connected with the radio outfits solved the problem

utes! How many people are familiar with the imagination-stirring details of this pictorial conquest of space? How many even know that it occurred?

Somewhat crude, but wholly recognizable, was the Harding portrait as received at the Paris end; and surely from the germ of this first wireless picture, progress to future radio broadcasting of moving news-photographs while the events pictured are actually taking place seems no more impossible than many another modern miracle that has been accomplished by science.

In general, the wireless outfit with which M. Edouard Bélin sent the Harding picture is the same as that with which he sent pictures over telephone and telegraph wires, as described a year ago in Popular Science Monthly. A new method, however, is utilized to keep the two cylinders, thousands of miles apart, revolving at exactly the same rate of speed. On one of the cylinders is pasted the picture to be transmitted, and sensitized paper on the cylinder at the other end is acted on by a beam of light, reflected under the control of radio waves, which are, in turn, governed by a needle moving over the sending cylinder. In wireless transmission, these

cylinders are operated by small dynamos instead of by clockwork, and their uniform movement is assured by a regulating chronometer with electric contacts, which stops and starts the cylinders at each revolution. The simultaneous starting of the two cylinders would be assured by the two regulators if the latter could only be made to keep perfect time, but this condition cannot be realized. In order to overcome this difficulty, M. Bélin has devised the following method: At each liberation of the transmitting cylinder, the wireless station sends out a dot similar to the noontime signal. The receiving station does the same and the operator of the latter adjusts his apparatus until he hears the two dots simultaneously.

In sending pictures long distances by wireless, it has been necessary to reduce the cylinders' speed from two revolutions a second—the time for wire transmission—to one turn in four seconds, making the time required to transmit a picture twenty minutes instead of two and a half. Compensating for this delay, however, is the belief that Bélin's system may make wireless stations independent of electrical disturbances which frequently "ball up" ordinary wireless messages.

At certain hours and seasons, electrical storms drown the dots and dashes of the Morse signals, and produce so much interference that it is often necessary to repeat a message two or three times before it is comprehensible. These repetitions reduce the number of messages that can be handled by a wireless station, and most of the day's communications are crowded through in certain hours when atmospheric conditions are favorable. A message sent by Bélin's system, on the other hand, goes in facsimile, each letter

being taken down at the receiving end in its characteristic written form. Even if "static" interferes with the transmission, enough of each letter will be reproduced to render the message legible. It is not necessary to make a photograph of the written message before sending it. The writer uses special ink that gives sufficient relief for the sending-needle to feel when the paper on which this raised message is written is rolled on the sending cylinder.

Another disadvantage of ordinary wireless which the Bélin apparatus does away with is the fact that any message sent by radio is practically howled out for all the world to hear. Engineers are hopefully at work on plans which will ultimately assure



Fingerprint reproductions, as received over the wire in Paris, three minutes after they had been taken from a captured suspect in the provinces. Thus is realized the prediction made by Popular Science Monthly last January, that the apparatus of M. Bélin would prove invaluable in running down criminals.

secrecy in wireless messages, but the fact remains that to-day practically any message can be heard by almost any wireless station that has the capacity to receive the sender's wave lengths.

It would seem, in the case of M. Bélin's apparatus, that any given station likewise might capture the picture that was being sent, simply by tuning to the right wave length. The sending cylinder probably wouldn't correspond in speed of revolutions to the receiving cylinder that was "listening in," the photographic points would therefore be more spaced out or more closed up on the receiving cylinder than on the sending cylinder; but even so, there is still a chance that they would remain legible. However, if the transmitting cylinder revolved in an irregular way, stopping and starting at unexpected intervals, the result produced on a receiving cylinder turning uniformly would be an illegible scrawl.

The points would be out of place both vertically and horizontally.

It is this little trick that M. Bélin expects to use for sending written messages in secret. He is perfecting a compact secret-message apparatus that can be kept upon any desk. With an equipment of this kind, the foreign representative of an American business house could write personal messages to his home office, to be transmitted from the cylinder on his desk by telephone, cable, or wireless. Using a rhythm of revolutions agreed upon by code, he could be certain that nobody except the operator of the receiving cylinder that was adjusted to the secret rhythm could understand a word.

World-important diplomatic interchanges, when this system is finally perfected, will be carried on by an actual exchange of authentic handwritten documents, carried broadcast through the air, yet secret from all but sender and receiver; while men in New York will be able to close important deals in San Francisco, instantly transmitting endorsed checks and signed contracts across the continent.

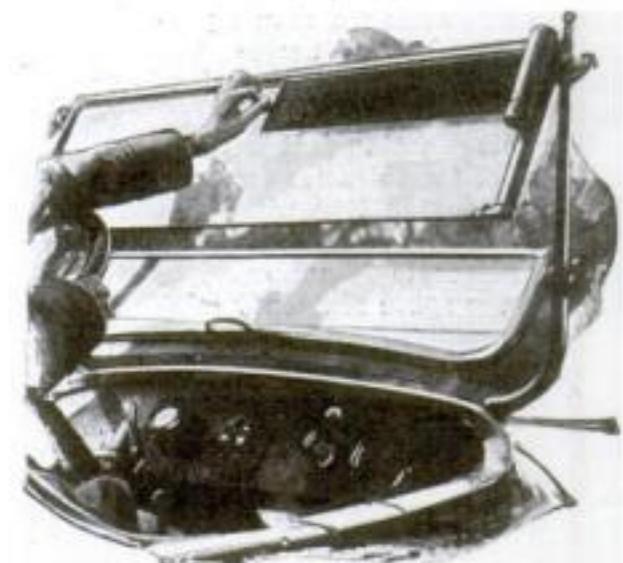
Machine Ties Parcels as Reaper Binds Grain



ELEVEN years ago J. J. Bachmayer was in the vegetable business. His fingers got so sore tying bunches of onions and radishes, that he determined to invent a parcel-tying machine. A year later he built the first machine out of old junk and bicycle sprocket wheels. For seven years he struggled to get people to use it, but it was not until 1917, when a machine was developed for tying candy-boxes that the company had any great success.

The machine is electrically operated. A box or parcel which is to be tied—the length or width does not matter, but the height must not exceed five and a half inches—is passed over the recoil trip, which pulls the twine around one way, and ties a neat, strong knot without waste of cord. To tie the package both lengthwise and crosswise it must be passed through the machine again.

The tying action is based upon that of a self-binding reaper, but this machine ties the twine tightly in the first place, instead of tying a knot in a loose cord while the straw is compressed, and relying upon the expansion of the bundle to tighten the knot.



Cylinder on Automobile Wind-Shield Contains Sunshade

THOSE who find their pleasure behind a steering-wheel will appreciate this sunshade, which is neat and compact and unobtrusive when not in use. The driver is shown pulling it across the wind-shield where it is hooked to a special attachment. The shade is of green silk.

When unhooked, the shade flies back into its container. No screws are needed to attach this accessory, as it is provided with clips which snap instantly over the ends of the wind-shield.

Watch for These Features Next Month

- Travel by Pullman Auto Bus
- How Music-Rolls are Made
- Trawler Seeks Sunken Treasure
- Your Family's Heredity Chart
- New Japanese Plane-Carrier
- Subway 400 Feet Below Surface

Earth to Plow through Broken Comet's Wreckage

How science explains November meteor shower

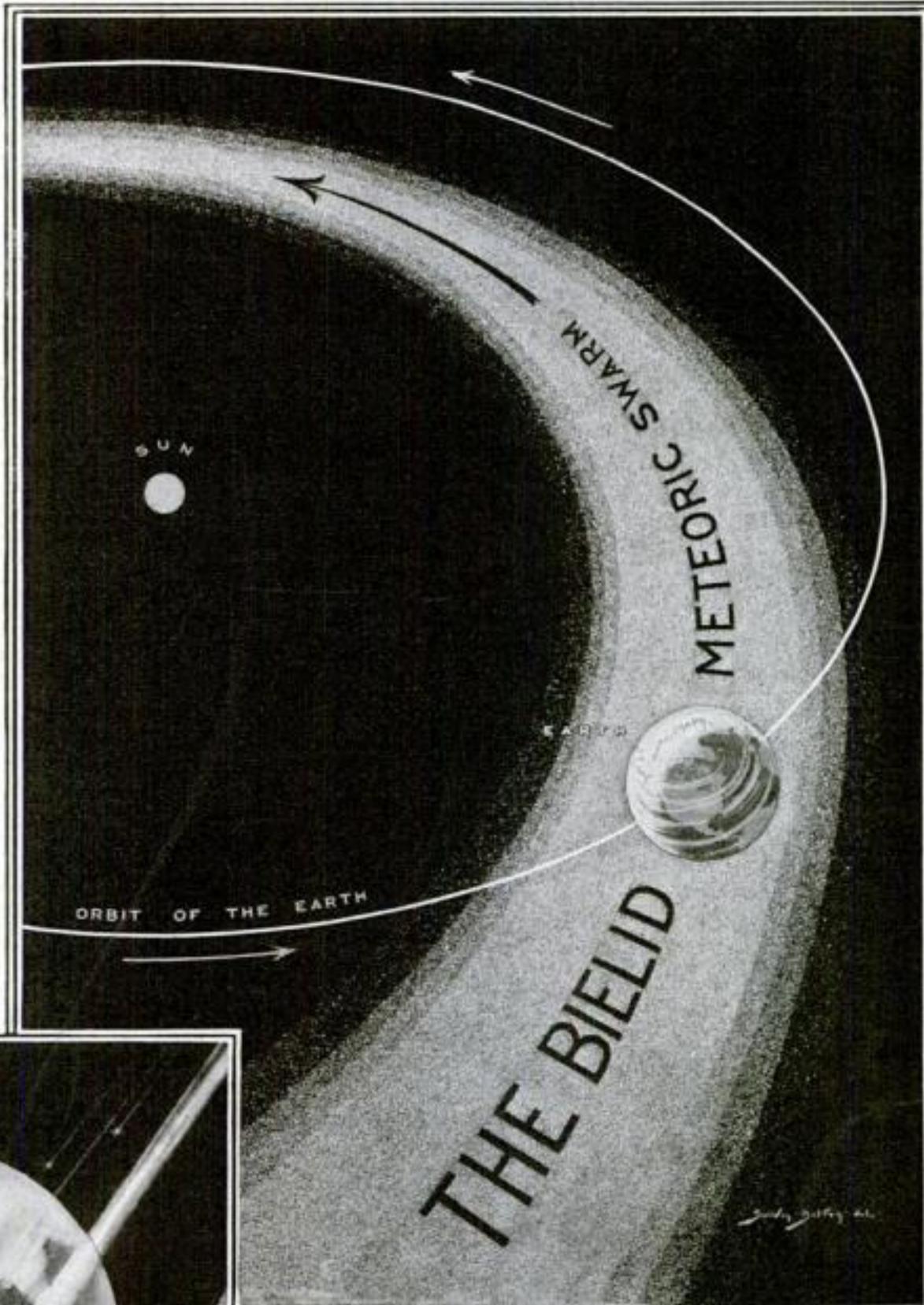
EARTH'S biggest adventure this month will be its collision with a sort of celestial sandbar—a vast, sweeping path through the heavens composed of a lost comet's debris, whose myriad fragments, rushing into our atmosphere at twenty miles a second, will furnish one of the regular November showers of shooting stars.

Just why displays of meteors should thus enliven the night skies—especially in August and November—often puzzles the average observer.

Astronomers now explain that nearly every annual spray of falling stars originates in the earth's rush through the swarming track of broken-up comets' wreckage, and that in our orbit around the sun we naturally strike these tracks at the same time each year. The meteors due on November 27, for instance, are the remains of Biela's comet, which, straying into the solar system from outer space, apparently couldn't stand the strain and began to break up under the pull of the sun and of the various planets among which it rushed in its elliptical course. Our earth nearly collided with the head of this comet in 1832, passing only two and a half times the earth's diameter away from it.

When Biela's comet returned in 1845, it was observed to split into two comets. The smaller one lagged behind until the distance separating them was 160,000 miles. In 1852, the distance between the two had widened to 1,300,000 miles, and was still increasing.

© Modern Publishing Company



How Scriven Bolton, famous astronomer, pictures the earth's annual November rush through the vast shoal of meteor fragments left by Biela's lost comet

Comet particles, myriads no larger than a pinhead, others sometimes bigger than a man, flash into flame as they strike our atmosphere and are quite burned up before reaching the ground

After this return the comet was never seen again, except in a changed state. On November 27, 1872, the date of the earth's passage across the comet's orbit, a tremendous shower of shooting stars occurred from 6 P.M. until midnight, and it is thought that our globe actually crashed through the disintegrated head of the comet itself.

The fate of Biela's comet is not an isolated instance. Several cases on record show that the subdivision and final disintegration of many comets is not an uncommon occurrence. A comet's head is believed to be a bunch of meteorites, ranging in size from stone and iron blocks weighing many tons, down to the finest powder or dust. Burned up by friction when they hit our atmosphere, few of these fragments ever strike the earth, although it is estimated that over 146,000,000,000 of them bombard us annually.



Where the "Last Discoverers" Are Now Seeking New World Riches for Mankind

Earth's few remaining unknown spaces are being "mopped up" by an unprecedented number of explorers

WE are living to-day in the greatest period of exploration that the world has ever known. During 1921 hundreds of men have gone forth into the waste spaces of the earth seeking at the risk of their lives new wealth and knowledge for mankind's benefit.

Coal, oil, minerals, new medicines, and precious stones represent in part the objects of their search; but more than that, this vast after-the-war revival of exploration is apparently going to clean up earth's last remaining mystery spots.

With one or two exceptions the hundreds of explorers in the field to-day are not striving for spectacular goals of discovery. Rather, they are consolidating the gains in our knowledge of outlying portions of the globe made by the Pearys and the Scotts who went before them. They are "mopping up" the earth.

The last objectives to which the explorer has yet to push are shown on the accompanying map, the black portions of which represent large areas of the earth of which we know absolutely nothing.

This year sees Lieutenant-Colonel Bury on his way to climb Mount Everest, the

By Ralph R. Perry

world's highest mountain and the one really spectacular goal left since the winning of the poles. Parties will soon push into the virgin wilderness in the interior of New Guinea. Before long some exceptionally daring adventurer will cross the untrodden Arabian desert of Roba-el-Khali.

"Mopping Up" Arabia and India

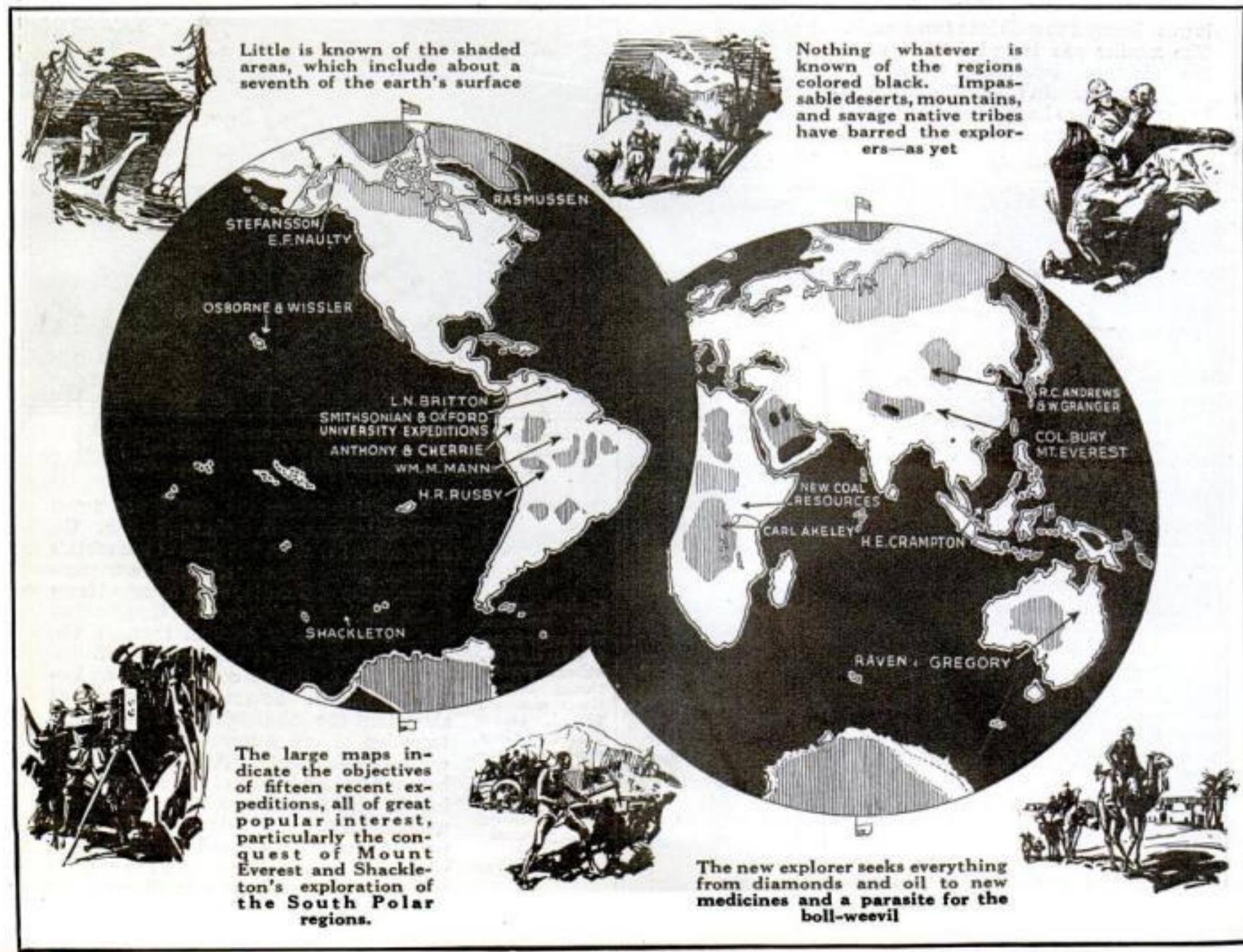
Roba-el-Khali is shown on the map in the interior of southern Arabia. On its outskirts there are petroleum springs. What lies beyond, no one can say. There may be more oil there, but not even the native Arabs have crossed this waste of shifting sand and naked rock, blazing under a tropical sun that makes it the hottest portion of the earth's surface. If a man were to take young she-camels in full milk and push out in the spring, some explorers think that this waste might be crossed, but as it is 850 miles long and 650 miles wide, no one has made the attempt, as yet. It is the largest blank space on the map.

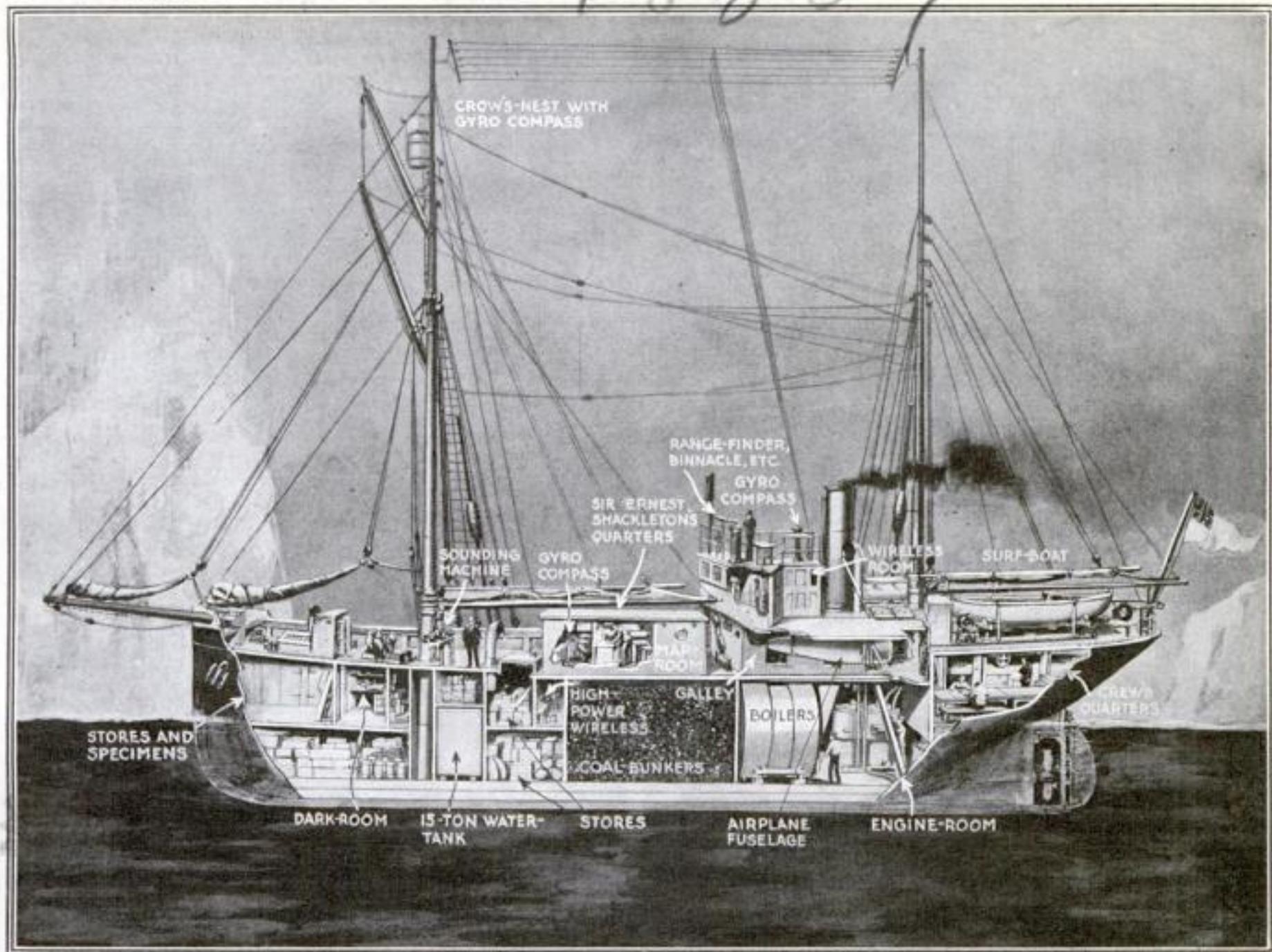
To the north our chart shows two

smaller, divided dark spaces. These formed one area a few years ago, but this year travelers pushed through from north to south, and we now have some information on the country lying thirty miles on either side of the route.

At the foot of Mount Everest is the kingdom of Nepal, of which we know nothing except from the reports of natives. It is an independent Mussulman kingdom, and the maharajah refuses to permit a white man to set foot in his kingdom. A few men have penetrated the southern border, but only for a short distance. Even the party which is about to climb Mount Everest was refused the right to cross Nepal, and was forced to make a detour into Tibet and will climb the mountain from the northern side. Nepal will probably be the last unknown area on the map.

The same condition exists in the interior of New Guinea, where savages attack every exploring party that has left the coast. This island is owned by Great Britain, Holland, and France, and a combined expedition equipped for resisting the natives was about to set out when the outbreak of the war postponed the attempt.





The diminutive "Quest," only 111 feet long and 200 tons displacement, in which Sir Ernest Shackleton will survey the Antarctic. Balloons, a baby airplane, and special ocean sounding apparatus comprise part of the equipment carried

It is to be resumed in the near future, since the forests of the interior are believed to be rich in natural resources.

The largest unknown areas, of course, are those surrounding the poles, but the expeditions of Shackleton and Stefansson are constantly adding to our knowledge of these sections. Among the parties now seeking new knowledge in the Arctic is that of Donald B. Macmillan, which will make special studies of polar magnetism and the aurora.

How Little We Really Know

Outside of the Arctic, it is true, we know something about nearly all the rest of the earth—but in spots it is very, very little. Throughout the vast shaded areas on our map we know little more than the courses of the navigable streams. The whole of northern Canada is practically unknown, and what undreamed-of possibilities may lie there are hinted at by the recent discovery of oil on the Mackenzie. The same is true of Siberia, the Sudan, almost the whole of interior Africa, central Asia, and the deserts of Australia. When the French pushed into the Sudan, which was thought to be well mapped, they found streams and oases from fifty to a hundred miles distant from the points the maps declared them to be located—which would indicate that our geographical knowledge is nothing to boast of. In the valley of the Amazon there are three areas, each larger than the New England States, of which our knowledge is the slightest. Although Africa has been crossed and recrossed from

end to end, the traveler is not surprised to find that water is often from one- to two-days' march from the points indicated on the map—which is apt to be fatal, in a dry country. If the day of the explorer is over, there was never such an opportunity for scientific expeditions.

These are made up of parties of five or six men sent out by the great museums and societies of the various nations. They live in the wilderness for months, even for years at a time. One man will make a careful map. A geologist will study the underlying rock strata, a zoologist gathers data on the plant and animal life, the anthropologist learns the habits of the primitive natives, the entomologist collects new species of insects, and when all have completed their work, scientists possess full and exact data on the conditions existing in the country, and the possibilities, if any, for commercial exploitation.

At the present time literally hundreds of these expeditions are in the field. We have shown some fifteen of the more important on our map. In the Antarctic, Shackleton is sailing in search of an island. The charts show two large islands in the Southern Pacific—Dougherty Islands and the Nimbros. Is there really any such land?

Nearly a hundred years ago whalers claimed to have sighted an island there. No one has ever seen it since. If the islands do exist, if it was not a mirage or a floating iceberg that was seen, the land would make a useful radio station in the chain which is rapidly encircling the globe. Shackleton intends to search until he either finds these islands or proves definitely that they do not

exist. Then he will sail farther south to the Antarctic ice, to chart 3000 miles of unknown coast, to discover new sites for coaling, whaling, and wireless stations, and to make deep-sea soundings.

Scientific Research Inspires Explorers

The new spirit that has arisen in exploration since the discovery of the poles is manifest in the records of the two expeditions by Captain Scott. In the first, which was before the discovery of the South Pole, he simply made a dash to the farthest point south ever reached. This was pure exploration. In the second expedition, in which he lost his life, he was actuated by the newer scientific motives. His party had found thirty-five pounds of fossil bones that gave evidence of the life that existed in the Antarctic before the formation of the polar ice—specimens of incalculable scientific interest.

On his return, food failed, oil for heat gave out, his party was so overcome by privation and weakness that one of their number deliberately wandered out into the darkness to die in order to conserve the food supply of the rest. The men tottered toward their base camp and safety by pitifully short marches, discarding everything that impeded their progress—but to the very end they dragged those thirty-five pounds of fossils. They had set out for scientific evidence and knowledge, and although they died, the fossils were found in their last camp by the rescue party. It is this spirit that actuates the later-day ex-

(Concluded on page 111)

18693
Civilization Must Abolish War
Prophetic pictures, based on statements by famous men,



These pictures reveal the alternatives to the prevention of another world war. Public opinion is awakening to the fact that unless the Washington Disarmament Conference paves the way toward peace, no mode of destruction will be banned in the next conflict.

THE INVASION—"Fleets of fast-moving tanks equipped with tanks of liquid gas, against which the enemy will probably have no protection, will cross the frontier and obliterate every living thing in the fields and farms, the villages and cities of the enemy's country. While life is being swept away around the frontier, fleets of airplanes will attack the enemy's great industrial and government centers. All these attacks will be made against the civil population in order to compel it to accept the will of the attackers."—Lieutenant-Colonel Fuller, Chief General Staff Officer of the British Tank Corps.

THE NEW TANKS—[They will be] "organized in large units, with General Staff tanks, telegraph tanks, tanks carrying . . . will be armed with

machine guns, and guns of all calibers."—General Eugene Debay, Commander of the French First Army during the war.

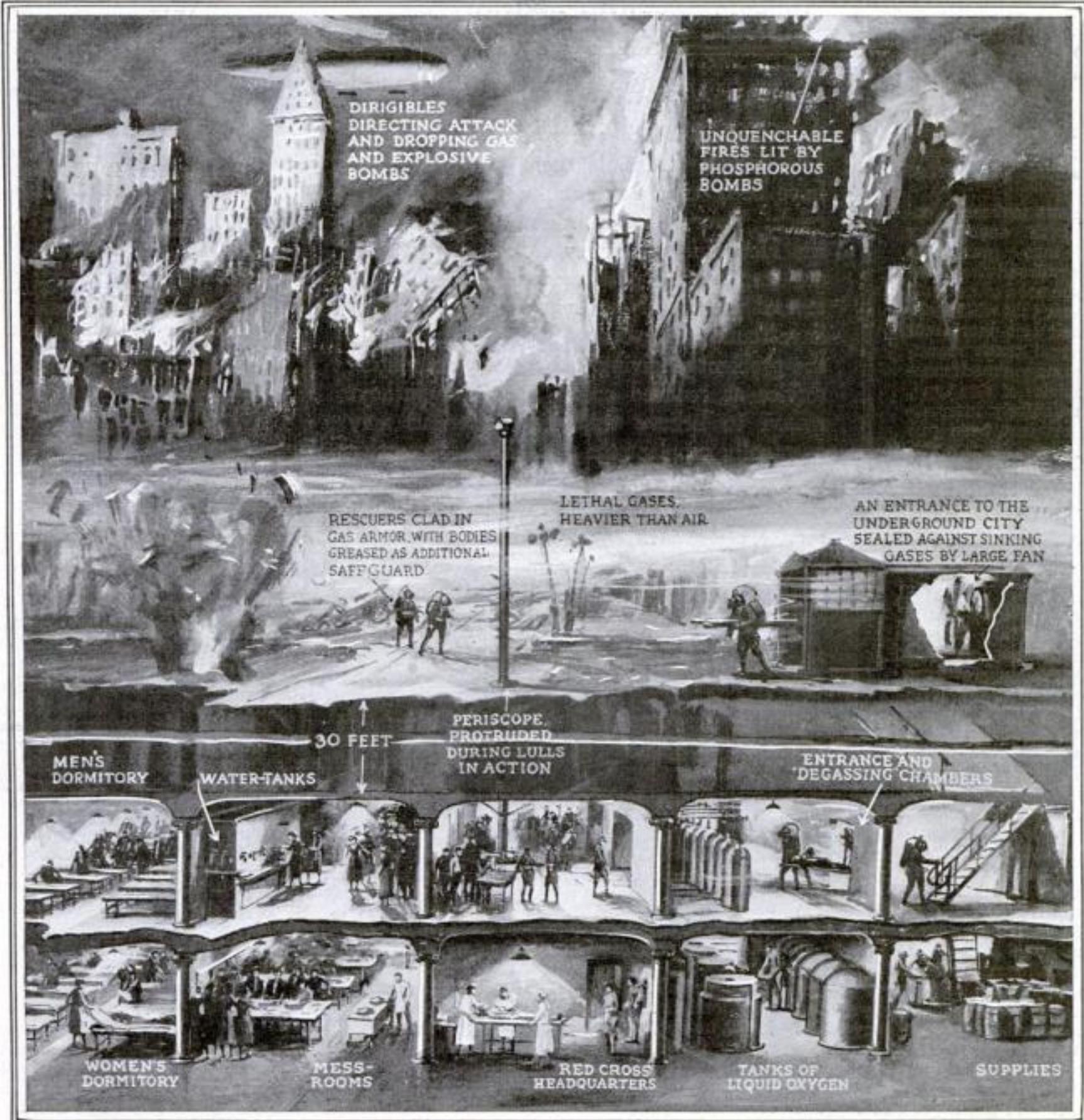
LETHAL RAYS—"I imagine from the progress that has been made in the past—that in the future we will not have recourse to gas alone, but will employ every force of nature that we can; and there is a tendency at present for progress in the development of the different forms of rays which can be turned to lethal purposes . . . which will shrivel up or paralyze or poison human beings if they are unprotected."—Major-General Swinton (British), one of the tank inventors.

The soldier of the next war will be clad constantly in gas armor made of impervious materials smeared with chemicals. The suit pictured was developed by the American army



or War Will Destroy Civilization"

show why disarmament is the great international problem



There will be no declaration of war. Hostilities will be inaugurated by myriads of airplanes and fleets of tanks. A few hours later will come gas bombardment of great commercial and industrial centers, killing hosts of civilians or driving them belowground.



At least one great power is known to beatwork on a machine by which lethal rays can be directed at the enemy's military and civil centers

THE BOMBARDMENT—"In 'the next war' this gas bombardment of capitals and great towns is not only a possibility but a strong probability—almost a certainty." ". . . cellars will never form a defence against sinking lethal, cell-killing gases like lewisite and its probable successors.

"The shelters must be large enough to accommodate the people of a whole city; they must be deep enough in the ground to resist the enormous explosive force of the great new bombs; they must be gas-proofed, either by rendering them airtight and furnishing oxygen to keep the inmates alive, or by providing ventilators which make the outer air pass through an antidote.

"They must be as easily accessible as a subway—even more accessible. This

virtually involves rebuilding modern cities, if the inhabitants expect to survive a war."

... "Had the war continued, Paris would have been attacked from the air on a new plan.

"A first wave of airplanes would have dropped on the city roofs tons of small bombs which released burning phosphorus. . . . It would have started a conflagration against which the fire department would have been almost helpless, in a hundred quarters of the city.

"Into the light furnished by this general fire the Germans proposed to send second and third waves of airplanes loaded with heaviest bombs. . . . From that the gas bombardment would have been but a short step." — Will Irwin, famous war correspondent, in "The Next War."

Railroads Use Motor-Buses to Improve Service

Motorized equipment now used on short lines is designed to compete with highway buses

RAILROAD passengers may soon be riding in a new type of gasoline-driven car which will operate over many short branch lines and interurban routes more cheaply than steam or electric trains.

After various makeshift experiments with auto-trucks converted into passenger coaches, the railroads have begun to feel the need of a standardized rail-car that will regain for them their lost short-haul traffic. Several truck manufacturers are now experimenting with vehicles of this type, and one particularly interesting model has just been put upon the market. It is a significant advance in the never-ceasing struggle for cheaper and more convenient transportation.

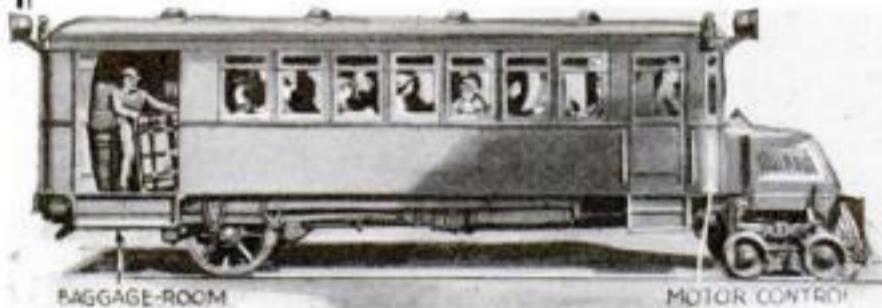
This Car Is a Hybrid

The new car is neither a motor-truck with flanged wheels nor a railway-car with a gasoline engine, but rather it is a happy and sensible combination of the best elements in both. Its power plant, consisting of engine, clutch, transmission and their accessories, is founded on motor-truck practice, but the wheels, brakes, the body, and its appointments are "railroad style."

Gasoline-driven railway-cars are not new; neither are motor-buses with railway wheels. But a hybrid vehicle combining the best features of both is as novel as it is interesting. It represents a deliberate attempt by one of the leading truck manufacturers to get railway business, and to get it by giving the railroads something that they want acutely but heretofore have not been able to buy; to wit: a thirty-one-passenger vehicle that can be run for fifteen cents a mile, or a thirty-six-passenger-and-baggage car that can be run at twenty-five cents a mile, including interest on investment and depreciation charges. It costs one dollar and fifty cents to two dollars a mile to operate a railroad-train of two or three cars, each car having a seating capacity of seventy passengers. Railroads that are losing money on short-haul passenger traffic have already found that a gasoline rail-car will turn losses into profits. As an example, there is a sixty-mile railroad in the western part of New York State, serving a rural population of about ten thousand. The volume of passenger traffic is not sufficient for profitable operation of one train a day in each direction. Therefore, no passenger service is offered, although there is a freight-train every other day. The rail-car makes passenger transportation economically feasible on this road. Assuming one car makes a round trip each way, a total of one hundred and twenty miles, at fifteen cents a mile, the

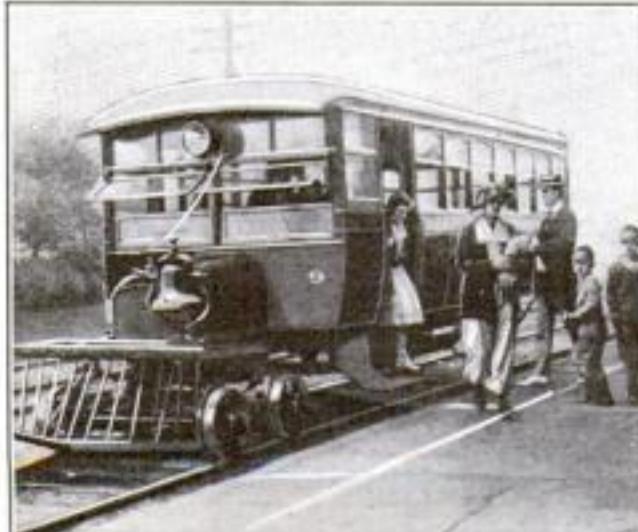
A New Vision of Railroad Service

MOTOR-BUSES equipped with flanged wheels to enable them to run on rails have been tried successfully on many short roads. Over a sixty-eight-mile stretch through the Hetch-Hetchy Valley of California, buses are transporting passengers and freight. In several parts of New England large railroads have found motor-buses to be the solution of the problem of giving satisfactory commuting service at reduced cost. It is not without reason to believe that the motor-bus may eventually supplant the coal-driven locomotive on the numerous branch lines. The substitution would mean faster and more frequent service, cleaner travel, and lower transportation costs.—The Editor.



One of the motor-cars developed especially for the N.Y., N.H. & H.R.R. for use on their branch lines

total cost is eighteen dollars, and if an average of only twenty passengers is maintained, at three cents a mile the revenue is seventy-two dollars a day, or a profit of fifty-four dollars. Furthermore, there is no question but that much additional business might be obtained by making several trips a day instead of one. On the average branch line, the public is served by one two-car train each way each day. The same seating capacity may be obtained by four rail-cars. Service four times as frequent is thus offered at less than half the cost. In the eyes of the public, service



A motor-bus has been operating this past summer on the Narragansett Pier branch of the New Haven lines with complete satisfaction to the patrons

four times as frequent is four times as good.

The rail-car not only gives the railways an opportunity to make money on branch-line passenger service that they now offer, but it will enable them to win back a sizable percentage of the traffic that has gone to the motor-bus and the motor-car. On a conservative basis, it is estimated that the railways annually lose \$200,000 in revenue because of competition by road vehicles. Much of this revenue has been lost because the railroads have been unable to compete with frequent service. A train once or twice a day could not be considered by a traveling public that could obtain motor-buses every few minutes or every hour, or an automobile at command. But the frequency of service which the low-cost rail-car offers will do much to bring back a large share of this business.

It is expected that many interurban electric lines that because of recent conditions in the traction field have been forced to allow their rolling stock, power houses, overhead trolley system, etc., to run down, can recuperate quickly by the purchase of rail-cars of this type.

On steam lines the car's use is not confined to "feeders" and short branch routes, but will be extended to commuting service in the off-peak hours and to regular off-season service on longer lines that cannot afford to operate with steam, except in the tourist months.

Thirty-Six Persons and Baggage

The rail-car in its latest form has a roomy body for thirty-six passengers, with a baggage compartment in the rear. Passengers enter and leave through doors at the front. The vehicle is propelled by a four-cylinder engine with six-inch stroke, to which is connected a clutch and four-speed transmission. The engine is provided with electric starter and generator. Up to this point the machine follows standard truck practice. But the four-speed transmission has combined with it a reverse gear that connects with all four speeds. It has a maximum speed of thirty-five miles an hour, and because of its high gearing a bevel-gear rear axle is employed.

A four-wheel pony-truck supports the car at the front, and a single pair of driving-wheels is used in the rear. Regulation brake-shoes act on all wheels. The driver's compartment looks much like that of a motor-truck. Turning the wheel however, does not steer the car, but applies the brakes. When air-brakes are fitted the brake lever is placed on the steering column, and the wheel then operates the emergency brake.

What Are Your Chances for Success in Radio?

Read these typical romances of four poor boys who found the route to wealth and fame *via wireless*

By Armstrong Perry

THE sky is the limit in the radio game. The brief annals of wireless are packed with the names of celebrities and men of wealth who were "just ordinary kids" when the radio bug bit them. Their success is explained by the fact that they grew with the industry—and helped it to grow. And the point for you, reader, is that the industry is still growing, and growing at phenomenal speed.

Take, for instance, the dawning opportunities for radio operators on land. Hitherto few operators were needed, except at sea, but now throughout the world nations are being linked up by direct radio communication. In the United States, police and fire departments are beginning to use radio, as are the forestry service, news-

distributing agencies, hotels and business houses. The Federal Bureau of Markets is broadcasting daily reports, the Post-Office Department has a chain of stations for directing its mail-planes, commercial companies are establishing services between cities, and railroads are beginning to use radio for general message service. With every year the field will broaden and so will the need for experts in its various phases.

Undoubtedly, however, when the present shipping slump has passed, the sea will again offer the greatest opportunities and the biggest adventures to the new operator.

When he has secured his commercial operator's license from

the local office of the chief radio inspector, United States Chamber of Commerce, he will doubtless seek through the medium of one of the half dozen great radio and telegraph corporations a job on a cargo boat. However, luck and ability may place a good operator as assistant on a passenger steamship.

Now let's assume that you are the new operator and suppose that you get a berth as the only one on a slow-going freighter. You will discover that the captain begins to rely upon you for the information that will bring his ship safely to port. In the old days his ship had to plow along until a drop in the barometer showed the approach of a storm. But now your prompt

(Concluded on page 30)

FROM East Side schoolboy to millionaire radio engineer in eighteen years—this is the romance of William Dubilier.

It all started when, at the age of fifteen, he happened to pick up a book on wireless, by Marconi. He read three hundred pages at one all-night sitting, went to school next day, and that same night attended a lecture on wireless. The door-keeper tried to keep him out, but young Dubilier was already the get-there kind. He sat in the front row.

After the lecture was over, he hung around asking questions and making a general nuisance of himself, until, to get rid of him, the lecturer offered to allow him to carry the apparatus back to the hotel. That simple act decided once and for all his future. From then on, as long as the lectures were conducted, Dubilier could be found nightly, first in the audience and later as an assistant to the lecturer, switching lights and arranging the equipment.

So rapidly did he absorb the technique, that a few months later Dubilier was himself delivering lectures for Marconi, filling engagements of lesser importance. He was still in school, but he worked after hours and attended lectures when he was not giving them himself.

His next step was to get a night job with a wireless-telegraph company. It paid neither salary, commission, nor



William Dubilier

Eighteen years ago a poor schoolboy, interested in radio; to-day one of the wireless industry's greatest engineers, the inventor of a condenser that has made his name known throughout the globe, and has earned him over \$1,500,000

expenses, but he considered the experience ample compensation. After holding the position five years, he won a gold medal at a World's Fair for an exhibition of radiophones.

At twenty-one years of age Dubilier had such a complete mastery of radio equipment that he was summoned by the Russian government to erect its new high-power station. His fame had preceded him. On his arrival in Russia, this boy, who was no older than many youths in high school, was installed in the royal palace, where for a month he was feted and entertained. The station which he erected at that time was the one that gave the world a jolt a few years later when the Russians, supposedly cut off from communication with Germany by a declaration of war, were found to be



Dubilier secured his earliest training by making himself assistant to the great Marconi during the latter's lecture tour



A few years later the lad from New York's East Side, now a leading radio expert, was entertained by the Czar

keeping in touch with the Berlin government by radio.

It was not Dubilier's fault that his station was used in double-crossing the Allies. Having unintentionally contributed to the wrong side of the world argument, he promptly struck a blow

for the other side.

A vital part of every radio transmitter is the condenser. The type in general use at the beginning of the war was the Leyden jar, a glass jar lined with copper. It was fragile, noisy in operation, and gave off quantities of ozone that seriously affected the atmosphere of operating-rooms. The Germans controlled the world's mica supply, so that the Allies could not change to a condenser using that dielectric, instead of glass. One day the Germans awoke to the fact that the Allies were using higher power and longer wave lengths than they had supposed were possible. After the war, it was discovered that among those who had been fighting from behind closed laboratory doors

was William Dubilier, whose condenser, constructed on new principles, had helped materially in condensing the German Empire.

Dubilier confesses to thirty-three summers. He can spend the rest of them at Bar Harbor and the winters at Palm Beach, if he wishes—he has the wherewithal. But his favorite resort summer and winter is the little old laboratory on Center Street, New York.

report concerning conditions ahead will enable him to dodge the storm area by a change of course. In the same way, it is predicted, radio will eventually supplant magnetic compass, chronometer, and lighthouse. Already it is recognized as indispensable. At harbor entrances automatic radio transmitters are being installed that repeat their exact positions at short intervals. Similarly from the mouths of well-developed harbors radio cables lead incoming vessels to their anchoring grounds.

Again, as a radio operator you may be able to get from ships in your vicinity their position reckonings and so supply your captain with a welcome check against his own computations. Then there are hydrographic reports of submerged wrecks, drifting derelicts, and buoys broken from their moorings. And usually twice a day time signals can be intercepted from the government observatories in several countries.

A Radio Operator's Perquisites

All this is routine; but meanwhile, remember, you are visiting interesting ports in every quarter of the globe without expense and with accommodations as good as those enjoyed by the officers and first-class passengers. When your ship docks, you are at liberty until sailing-time—and your uniform often admits you to circles closed to the man in plain clothes.

And all the time, too, you are making money. Pay for the beginner ranges from sixty-five to seventy-five dollars a month, while experts often draw more than two hundred dollars. This is in addition, of course, to your "room and board" and numerous incidentals, while many an operator finds opportunities to do other remunerative work on board. Thus, some write

radio articles for technical journals, others compile trade reports for exporting firms back home, and many study the science of navigation. But the "wise" delve deep into the still unsolved mysteries of their own profession. They know that the big men in radio have all been operators, amateur or professional, who have studied as they worked.

For the big men in radio once knew as little about the subject as you may know now. They realized that the time to begin is now, and the way to begin is to purchase a text-book and get busy. If possible, they would advise you to take a course at a good school, locally or by correspondence, or else to get a radio man to give you instruction. If his terms are high, help organize a class and split expense.

Free instruction, you may not know, is

now being given to civilians by the War Department. From corps headquarters powerful transmitters are sending instructions by radio, while other instruction is given by mail. Your questions will be answered. You will have a chance to be inducted into the signal reserve corps, being called to active service usually for the duration of the short summer encampment.

It takes little time to acquire proficiency. In my own case a government license was secured after only four months, and I want to make clear that I was

and keeps cash accounts and other records in proper shape. Mere technical ability counts for perhaps one third in your success as a radio operator.

But the big prizes in radio go to the operators who stick to the game and get into the executive or engineering branches of the business. Scores of important inventions are still to be perfected and many a practical operator and experimenter now beginning will reap the cash rewards for these achievements. Not one of the celebrities pictured on these pages had a better start than you who read this article. The

one brilliant quality I have been able to discover in them is the ability to stick to a thing after the keen edge of enthusiasm had been dulled by the inevitable knocks of drudgery.

They just kept at it and added a bit of knowledge and experience each day, with perhaps a double dose on Sundays. And every little while they have given the universe a jolt by announcing some discovery that was right under our noses all the time.

It is interesting that, of approximately 20,200 licensed radio operators in the United States today, 12,400 are licensed amateurs, leaving a total of 7800 who earn their living by operating. Of these 7800 only thirty-two hold commercial first-grade licenses, and only sixty-six of the seventy-eight hundred hold cargo licenses.

Cost of Learning Radio

Tuition for a course which will prepare you to pass the Government examination and receive a commercial operator's license will cost you about fifty dollars.

Books covering the same ground and used by many men for self instruction at home in place of a school course cost from \$2.50 up.

A simple receiving-set, composed of a mineral detector, a single phone and wire for aerial and ground can be purchased as low as one dollar.

Better sets, transmitting and receiving, can be built or purchased for from \$10 up.

A very liberal allowance for putting a beginner in a position to earn something from radio within a year is \$100. This is more than the average operator has spent for his education.

My own expenses, covering the four months from the time I applied for admission to the East Side Y. M. C. A. radio school to the time I received my commercial license were as follows:

Tuition	\$40.00
Text-book	2.50
Phone	2.25
Note-books30
Car-fares	10.00
Notary's fee for executing oath on license25
	\$55.30



Michal Idvorsky Pupin

whose epochal invention, the Pupin coil, brought him wealth and made long-distance communication possible

PREFERRING citizenship in the land of Washington and Lincoln to a life in Serbia as a general in the army, Michal Pupin sold his schoolbooks and an old watch and started for America.

He landed at Castle Garden at the age of sixteen, with five cents left in his pocket, and spent it for a piece of pie. He licked a newsboy who jeered at his red fez which a fellow immigrant gave him when his own hat blew overboard.

He spent his first three months in America working on a farm and studying English. Then he got work in New York and saved enough money for an education. He entered Columbia University with two hundred dollars in savings. There he won a name for his muscular, as well as his mental, prowess. As a wrestler he won the college championship.

A scholarship took him from Columbia to Cambridge, England. From there he went to Berlin, but Columbia called

him back to the professorship of mathematical physics.

His most widely used invention is the Pupin coil. Inserted at intervals in the line, this makes transcontinental telephony as satisfactory as local calls. With the coming of radio telephony, it was found that the Pupinized telephone lines easily took up the human voice, transmitted by radio from Catalina Island in the Pacific and automatically transferred to the land wires, carried it across the continent, and delivered it into another radio transmitter on the Atlantic coast loudly enough to make it audible on board vessels a hundred miles or more at sea.



Pupin, wearing a red fez, got his first glimpse of America from an immigrant ship

well past the age when men "learn easily."

"But surely," you object, "the profession must be overcrowded by now."

It is true that the current industrial slump has temporarily hit radio operators as it has all other classes, but nevertheless the fact is that in good times or bad there is always employment for the exceptionally good radio operator—and by that I do not mean a radio "wizard"; I mean an operator who can send and receive at commercial speed, keep his apparatus in condition and prepared for accidents before they happen, respect the laws governing radio communication, handle customers in a courteous and businesslike fashion, and who in case of service at sea—copies as much "press" as possible for the benefit of passengers and crew, is amiable with officers and associates,

He Used His Auto Horn to Get Wireless Message

WHEN Roy A. Weagant was still in short pants and bare feet, he built a telegraph set and cut in on a local circuit in his home town in Canada.

A discarded hand generator that fell into his clutches peeved him because he had to turn a crank with one hand in order to produce juice to operate his fearful and wonderful electrical devices. It was worse than trying to work a chain pump and keep your mouth under the spout. So he built his own storage battery to serve as a receptacle.

Thereafter, he turned his energies to the construction of a motor. He has not finished it yet, for before he could get all the parts together he went to McGill University to study electrical engineering.

He was mainly dependent upon his own resources. When grub was scarce, he filled up with an extra portion of Hertzian waves, now known as radio waves. He had telegraphed over

Roy A. Weagant

Chief engineer of the world's largest radio corporation. His experimentation has led to methods by which static interference is eliminated and weak signals from far-away stations are amplified



wires, and had found absorbing interest in those ether oscillations that made it possible to telegraph without any wires at all.

After graduation, he went to work. He's been working ever since—working hard; to that alone, or to that and the fact that he always got what he went after, he attributes the success that has made him head of the engineering forces of the largest radio company in the world.

When he landed a job with the Marconi Company—"by going after it," as he says—he soon became absorbed in research work, which ledulti-



Turning a generator with one hand as he operated the key with the other, Weagant learned his first lessons in electricity

mately to feats that have made him famous.

Weagant's outstanding accomplishment is the elimination of static interference. In addition to making it possible to receive signals in spite of atmospheric disturbances, he has also perfected a system of amplification that takes weak signals from distant stations and by means of relays makes them loud enough to be plainly audible.

"The other day," said Weagant, "I brought in POZ [the transmitting station at Nauen, just outside of Berlin, about five thousand miles away] strong enough to operate a relay. Summer-time—worst season for atmospheric disturbances. Sometimes hard to hear signals. Hooked relay to Claxon horn on my car. The horn started off at thirty words a minute. I'll say you could hear the signals!"

Sarnoff Tried Every Job from Office Boy to Manager

PEOPLE think that if a man gets a big job he must be a wonder. It is not so," says David Sarnoff, once office-boy and now general manager of the Radio Corporation of America.

"I came to America from Europe at ten years of age. I did not know a word of English. I started in school and worked when school was over.

"In 1905 I got a job with the Commercial Cable Company. Having caught the glamour of radio, six months later I went to the chief en-



Even while he worked at the telegraph key young Sarnoff was mastering the theory of radio from textbooks

gineer of the Marconi Company and asked him if he needed any men. He said: 'We don't need any men, but we need an office-boy at \$5.50 a week.' I grabbed the job. I learned how to work the telegraph key and learned the code by studying at home, nights.

"When one of the telegraph operators was transferred to wireless, I got his job. This was the turning point in my life.

I knew that the executives then in the office knew little about the practical end of radio. The real radio men were all down in the research department, or at the shore stations or on the ships. I believed that if I could get out of the office atmosphere and into the practical end of the business I could come back and have something the other men did not possess.

"In 1907 the company opened the Siasconset station and I applied for a job as radio operator. My friends in the ex-

ecutive offices told me that if I took the job I should be a sixty-dollar-a-month man all my life. I took the job, and in two years became a competent commercial operator. There was an engine, a generator, and a storage battery emergency outfit there. I did the dirty work because I wanted the experience. Nobody quarreled with me about that. I was only eighteen at the time.

"By 1912 our company had four hundred ships and fifty coastal stations. Men were needed as operators, and I was soon appointed an inspector, to supervise their work and our equipment. After that I was made successively chief inspector, assistant to the chief engineer, assistant traffic manager, contract manager, manager of the commercial department, and finally general manager.

"There is no country that offers such opportunities as America. I have traveled extensively and I know. And there is no profession that offers better opportunities than radio."

David Sarnoff

After his climb from office boy to general manager of a great wireless company, he declares that any boy with a definite object and persistence can win out



Every-Day Wonders

Easy Questions About Familiar Things—Can You Answer Them?

1. Why does alcohol cool the body when used externally, and seem to warm the body when taken internally?
2. Account for the appearance of frost on window-panes in winter.
3. What causes clouds to form? How high up are rain clouds?
4. Why should water reservoirs be without roofs?
5. How does a fire-extinguisher put out a fire?

IN each issue Popular Science Monthly asks ten questions that every reader should be able to answer. Follow them carefully and you will acquire fascinating knowledge about the secrets of science affecting our daily lives. See answers below.

6. Why is a burn from steam at 212° F. more severe than a burn from boiling water at the same temperature?
7. Why does water freeze first in pipes on the top floors of houses?
8. Would the householder who kept a wet cloth over his gas-meter be able to get more gas for his money?
9. What causes the black smudge to form on the ceiling above an oil or gas flame that is not burning properly?
10. Why does blue cloth look nearly black in gaslight?

Five Minutes a Day Will Make You Master of These Fundamental Facts of Science

Alcoholic Effects

1. When used externally, alcohol makes the body feel cool for the same reason that water does. In each case the liquid evaporates; and since heat is necessary to change a liquid into a gas, the water or the alcohol takes the heat from the body, to which it is closest.

When used internally, alcohol affects the nerves that control the small blood-vessels in the skin in such a way that they are dilated. This results in a rush of the blood to the surface of the body, which causes a warm feeling. On a warm day it is the heat of the atmosphere expanding the blood-vessels near the surface that gives us the warm feeling. But with alcohol as the dilating agent, what is actually happening is that the body is being unduly cooled, because so much blood is being brought to the surface of the body. Because of this fact a drunken man may freeze to death despite his first deceptive feeling of warmth.

Frost on the Pane

2. The air you exhale on a cold day cools to the lower temperature of the outer air. Warm air has a greater capacity for holding water vapor than cold air. Having been very warm in the body—the body temperature is 98.6° F.—your breath was able to hold large amounts of water vapor, but as it cools it must release the excess water, which therefore condenses into a cloud of vapor.

Now think of the window-pane of a warm room in winter. On one side there is air that holds a great capacity for moisture, because it is warm. On the other is the cold air that cools the glass through the inside surface. Inside, the people are living and the moisture that they exhale and the perspiration from their bodies are being absorbed by the warm air. As this moisture-laden air comes in contact with the cold window-pane, it loses its capacity for holding moisture and condenses, forming frost.

Height of Clouds

3. As currents of air are heated by the earth's surface, they rise and in rising expand, due to the gradually lessening

pressure in higher altitudes. In expanding, the air is cooled and condensed into minute drops of moisture, a large number of which form a cloud. Rain clouds are seldom higher than a mile.

Why are Reservoirs Roofless?

4. To allow the oxygen of the air and the ultra-violet rays of the sun to mingle with the water and purify it. The rougher the water as it is agitated by the wind, the more oxygen will be absorbed. This is the reason why the water in many purification systems is sprayed into the air as a fine mist.

How are Fires Put Out?

5. In either one of two ways. The more common is by wetting the burning surface to reduce its temperature below that of the temperature of combustion. The second method makes use of heavy gases that form a blanket over the fire, preventing the entrance of oxygen, without which a fire cannot burn.

Burns from Steam

6. It requires over five times as much heat to turn icewater to boiling water and then to steam as to heat the entire mass of liquid from freezing to 212°—the temperature at which water boils. This excess heat that goes into the steam must come out again when the steam strikes a surface and is cooled. It is the presence of this extra amount of heat—known in physics as the "heat of vaporization"—that makes a burn from steam more severe than one from boiling water.

Freezing of Pipes

7. Most substances shrink in volume as they are cooled. Water is no exception to the rule until it reaches 4° C. Then it ceases to shrink and begins to expand as it cools to 3°, 2°, 1°, 0° C., when it begins to freeze. As ice it occupies more space than it does as water. Now if water behaved normally, lakes and all bodies of water would freeze from the bottom up, killing the fish. But water near the freezing-point floats to the top because it is lighter and freezes there.

The Gas-Meter

8. As the wet cloth dried, the gas-meter and its contents would grow colder. Now, most things, including gases, expand when heated and contract when cooled. And when the gas in the meter contracts, more gas flows in to fill the space. This space is inside of a bellows arrangement which turns the dial indicator through a series of gears as it discharges the gas through the pipes into the room where the gas is being used. Therefore, if the bellows holds more gas, it will discharge its contents and register the same amount of gas on the dial as when the gas was warmer.

When Lamps Smoke

9. When a gaslight is burning properly, it is being supplied with enough air to burn the fuel completely, which may be gas or oil or kerosene. The light is usually produced by small particles of carbon coming from the fuel, which have been heated till they glow. But if the air supply is insufficient, a great deal of this carbon will leave the lamp-chimney or gas-tip unburned. This exodus of minute particles of carbon forms the smoke and the smudge that accompany the improperly burning lamp.

Color of Cloth

10. When a beam of white light, such as we get from the sun, shines on blue cloth, the latter will absorb all the colors that go to make up "white," except the blue, which it will reflect to our eye. The cloth then appears blue to us. In the same way, red cloth looks red when the light striking it contains rays that it reflects. Green cloth will reflect green rays, and absorb all others. Now, gaslight is usually deficient in certain colors; especially in the blues and purples. That is why gaslight is yellow. And so, because there is very little blue from the gaslight that the blue cloth can reflect, it sends practically no rays to our eyes. The blue cloth absorbs most of the other colors. Since practically no light comes to our eyes, the blue cloth appears black, which is merely due to the absence of light.

1898 + 1899

Railways of Odd Design from All Parts of the World



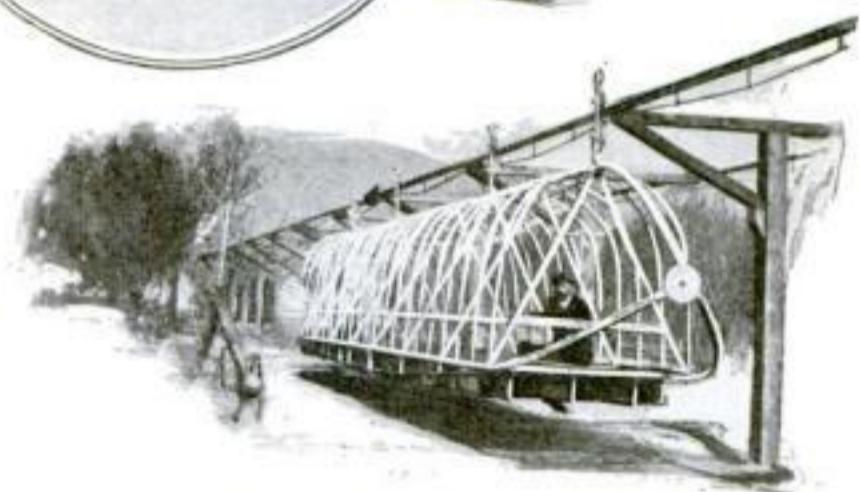
The famous suspended railroad of Elberfeld. By making use of the space above a canal, the elevated road is made possible without obstruction of street traffic



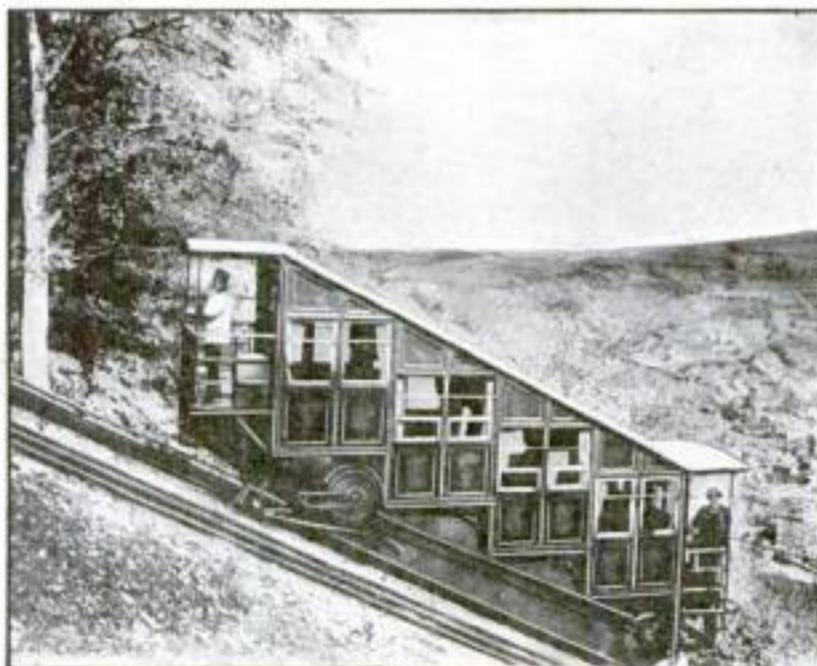
Autos now furnish the motive power for the trolleys in Apeldoorn, Holland. Each locomotive is capable of pulling three cars. Before the advent of these gas locomotives the cars were drawn by horses



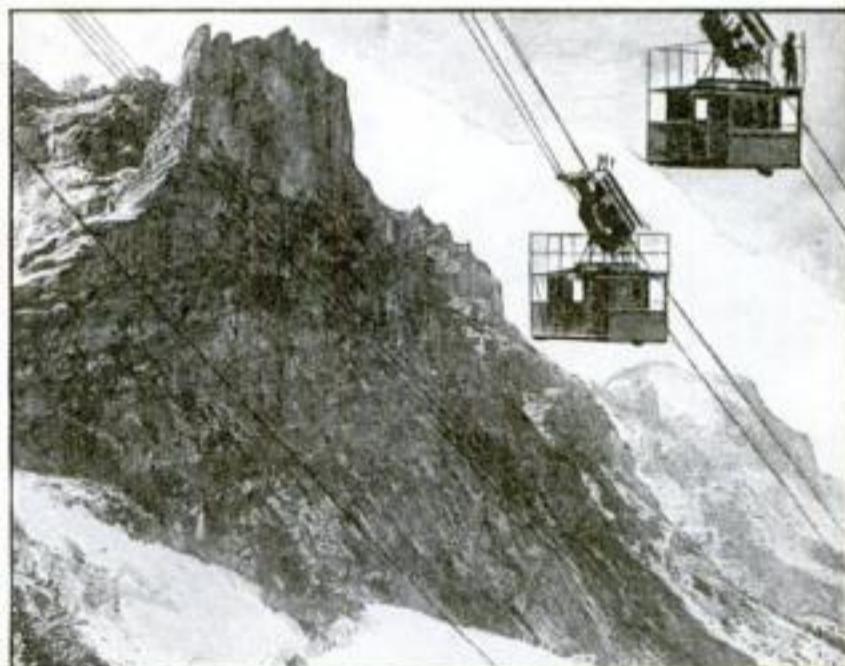
Two airplane engines and propellers, one on each end of this car, drives it at a speed of two hundred miles an hour. The car runs on a regular scheduled time between Berlin and Hamburg, Germany



This unique torpedo-shaped hanging trolley that does service in Burbank, California, has a seating capacity for sixteen persons. It is driven by a propeller at one end. Such construction is practical only in California's climate



The Malberg railway at Ems is built to conform to the steep slope of the mountainside. The passenger compartment is built in a series of steps so that the seats are always upright



Only intrepid Alpine mountain-climbers ascend the Wetterhorn in any other manner than by this cable railway. The peak of this mountain is over twelve thousand feet high

Getting Thrills out of Made-to-Order Collisions

EVEN if you don't own a flivver, you can have the pleasure of running into people. You can experience the sensation of having your automobile struck by another one, or by two or three at a time.

The sport is staged in an enclosure paved with sheet steel and with an overhead covering of heavy steel netting. There are parked within this well-fenced lot about twenty-five small cars that look like big tubs set on four wheels. The visitor takes his seat in this round flivver, and grips the steering-wheel firmly. Next he puts his foot on a big button. The effect of this pressure is to start things going in every direction. Each car has its own trolley, the wheel of which connects with the netting which forms the roof of the pen. As the metal strands are very uneven, and the car has no guide for its wheels, the motor, which



Cars driven from overhead trolleys supply thrills by their eccentric actions. Tempered steel springs on the base of the cars act as buffers

gets the current, causes the machine to go plunging around the place like a bucking broncho. The motive power comes from the overhead screen, which is charged with

electricity and which can be turned on or off at will by the electrician at the switch.

The effects might be serious, were it not that around the bases of the cars are projecting circles of high-tempered steel springs. When the cars collide, the shocks are easily broken by the metal absorbers. The amateur chauffeur has all the excitement without the broken bones that often accompany adventures on the road.

In the course of a few trips, one may become proficient as a pilot and even steer a strictly straight course. The worst performers in the arena are the skilled chauffeurs, who apply the principle of steering as they understand it and miss the idea. The wheel turns in

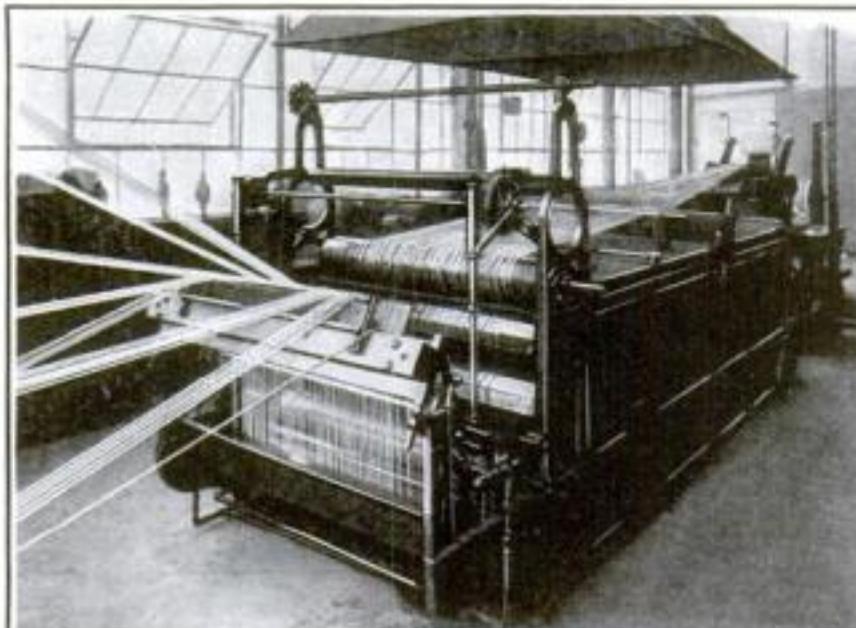
the reverse fashion of the automobile steering device, therefore the better driver on the road one happens to be, the more awkward he is under these abnormal conditions.

How Heatless Tires Are Made by New Process

INTERNAL heat, one of the chief causes of tire destruction, is said to be eliminated by the invention of a tire-manufacturing process that embodies seventy-three improvements. Each cord or rope in these tires passed through a machine called the beamer, which takes the place of the more familiar calender in tire manufacture and which coats each strand with an even layer of live rubber. During manufacture the strands sometimes adhere so that before the tread is applied it is necessary to go over the surface of the cords with a steel comb and separate the strands. With this composition, it is impossible for the friction of one strand on another to cause heat.

The cords are continuous around the bead wire. After the cord belts have been rubberized, they are taken to the cutting-room and cut into strips, each one of which will form one tire without waste or trimming.

There are only two splices in the whole

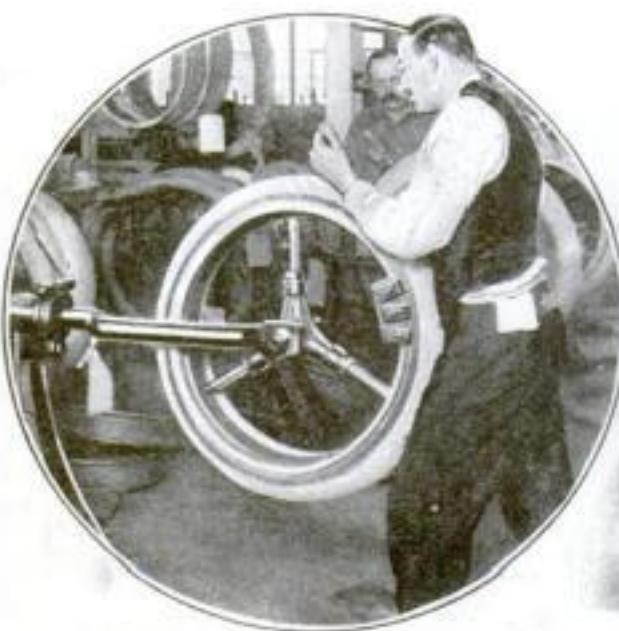


The beamer, showing the braided rope cord, each strand passing through a rubber bath and being coated with rubber

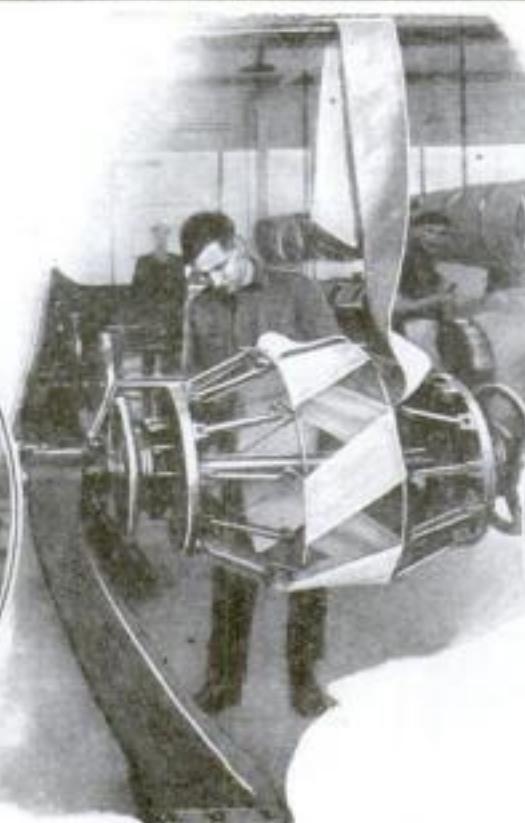
tire. As each rope is surrounded by rubber, it is free from the rest during the process of manufacture, and can twist and turn and adjust itself individually when the tire is shaped by the air process. At the same time, a patented device keeps each rope in the finished tire at exactly the same tension, so that every one carries its share of the load.

Because of the elimination of internal friction, it is said to be possible to build this tire with only two plies of cords, instead of the customary seven or eight layers of fabric. Long life is expected from the tire as a result of its great flexibility.

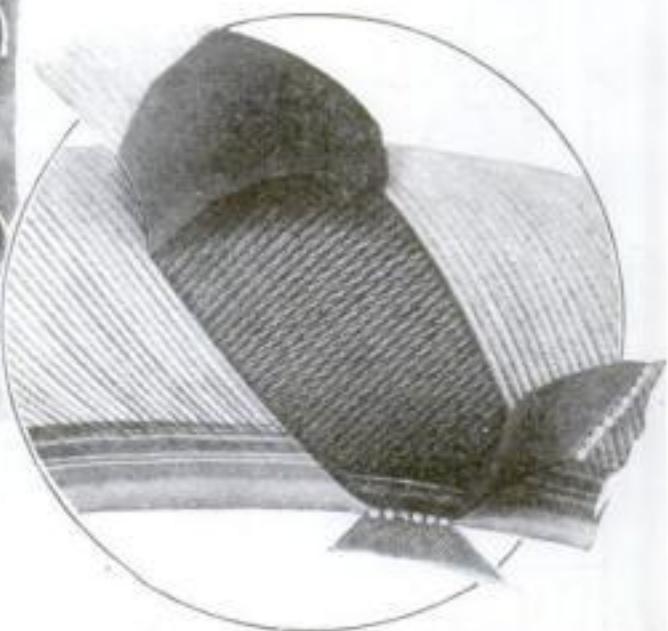
The inside lining is of rubber—a new feature, which the manufacturers say could not be successful if internal heat were generated, since the inner tube would then stick to this rubber lining. No soapstone or mica dust is required between lining and tube for lubrication, as the tube has no tendency to creep.



After the rubberized cords are formed into the tire, the strands are combed so that each cord is carefully separated from its neighbor



The cords come to this machine in long belts with a cushion of rubber along each side. The belts are wound diagonally around the bead wire guides



A section of the completed tire-carcass with one of the two layers of cords removed to show the assembly of rubber-covered cords



Hand Loom Produces Big Cravat Output

WITH a simple hand loom, crude in its design, but capable of work that compares with the finest, William Bennett, a disabled sailor, who was formerly a practical scientist and an optician of ability, has been turning out large quantities of silk ties in his improvised shop in the Dugout, a well-known New York institution for ex-service men.

Bennett has become so proficient with this loom of his own invention that he is able to weave ten to twelve silk neckties or belts a day. The handiwork is so fine that his product brings the highest prices.

Conveyor Handles One Hundred Tons of Flour an Hour

PORTABLE ship-loading units for freight in bags consisting of an electrically driven conveyor which can be moved anywhere about the dock and a tower by which the conveyor can be raised to any height required by the different classes of ships will greatly expedite the storage of cargo.

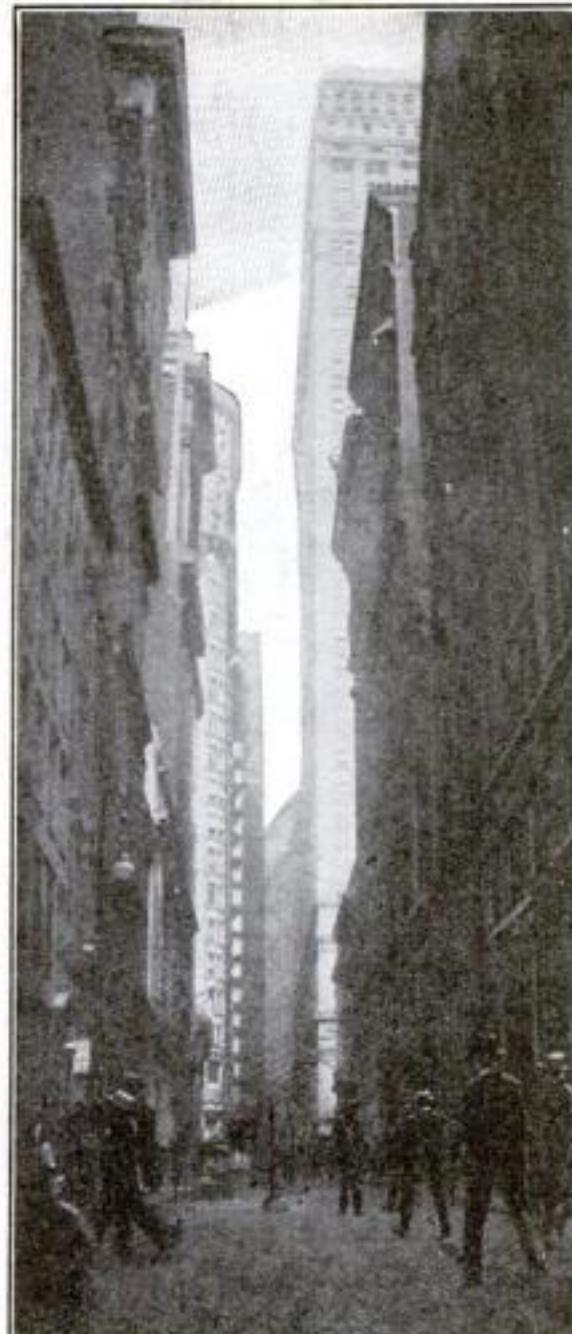
This new unit discharges the bags into the hold through automatic chutes. Thus the whole operation is made as nearly automatic as possible, and few stevedores are necessary.

By means of this conveyor ordinary bag flour is easily handled at the rate of one hundred tons an hour, and by speeding up, an exceptionally efficient crew has



Conveyors carry the bags from wharf to ship's hold at the rate of one hundred tons an hour

loaded as much as two hundred tons an hour. In this way great savings were effected, not only in wages, but by cutting down the length of time a vessel must remain in dock to take on cargo. Breakage and spoilage are practically eliminated, while the cost of loading flour is reduced from \$1.25 to 85 cents a ton.



Space in New York's Canyons in the Panic that Never Happens

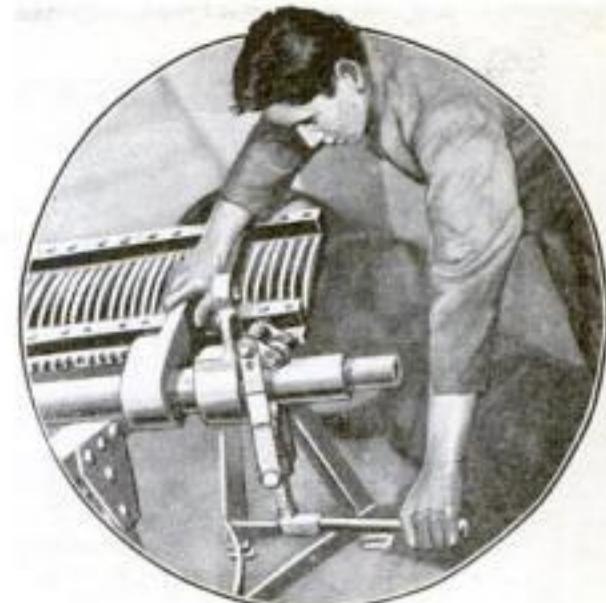
WHAT would happen on one block of New York's crowded streets if all the workers in the buildings were suddenly transferred to the street? Where Pine Street runs east from Broadway in New York City there is a thirty-six-story building extending along one side of the entire block. The average height of the buildings opposite is twenty-five stories. The total number who go and come to work via Pine Street is sixteen thousand.

The average man requires about two and a quarter square feet of standing space. If everybody in these buildings tried to stand in the street at once, the crowd would be packed nine tiers deep and 124 men would be left over. The street would be packed solidly with people up to the level of the windows on the fifth floor.

Boxes Fall Thirty Feet Unhurt

TO expedite the handling of heavy cases of canned meat between the packing floor and the shipping platforms an American concern has installed a shaft down which the cases can be dropped over thirty feet without injury.

No cushions or spring shock-absorbers are used. The air in the shaft is employed as a cushion. The shaft is made slightly larger than the dimensions of the boxes, and is arranged so that when the cases are dropped it is hermetically sealed at the top and the bottom. The falling box compresses the air in front of it and creates a vacuum behind it strong enough to drop it at the bottom without injury. This method has proved three times as fast as an elevator.



For Drawing Wedged Keys in Transmission Shafts

HOW to remove tightly wedged keys in transmission shafts without tedious hammering and without danger of scoring or otherwise damaging the shaft surface has long been a problem. The torsion of the shaft, heat, and rust all help to wedge the key tighter and tighter until in some cases it practically fuses with the shaft.

Instead of hammering patiently at the thin edge of the key in its slot, a German now uses his recently invented key-remover, which, because of its sureness and simplicity and safety, is likely to become a famous tool.

The device may be placed over the shaft at any place; it does not have to be slipped over the end—an advantage in the case of a long shaft with several pulleys. When it is fastened to the shaft and attached to the key, the turning of its screw brings a powerful leverage to bear on the key. The upper of the two rollers shown in the illustration comes down to the shaft surface like the other as the key is extracted. Rollers are used to protect the shaft. The continued turning of the screw until the upper roller reaches the surface of the shaft removes nearly every wedge.

However, if the key should resist this powerful leverage, it does not mean that the remover has not functioned. Either the key is pulled or the pulley is pushed—one or the other. And, of course, when the pulley is shoved past the key, it is no longer difficult to extract the wedge.

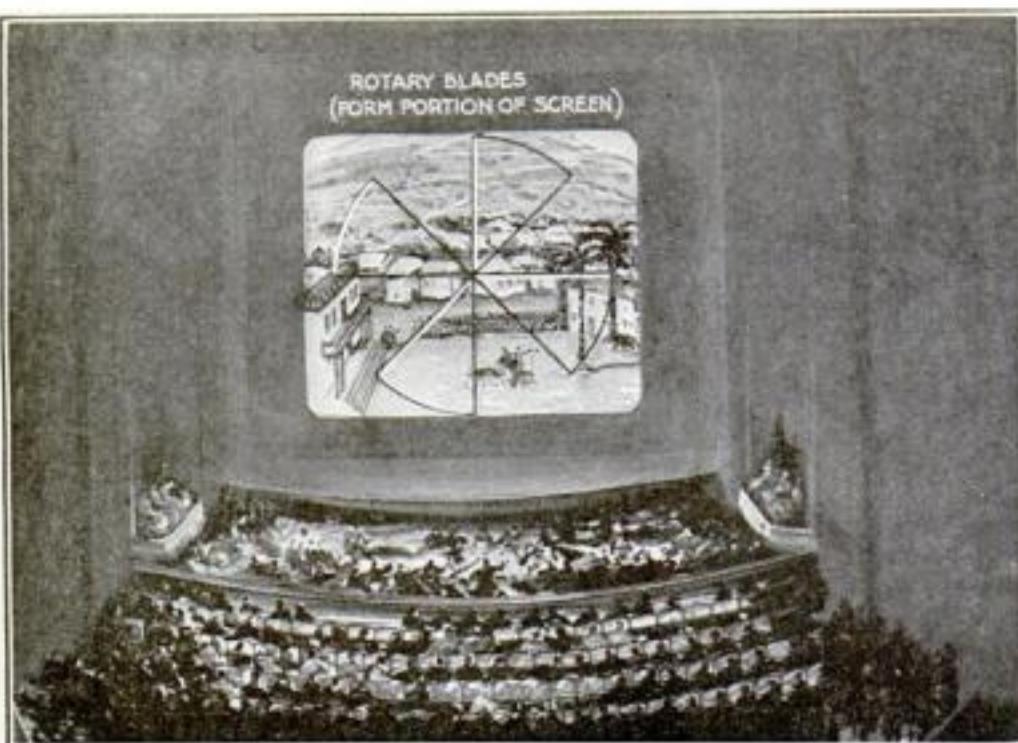
Raising Figs instead of Thistles

IRRIGATION and the tractor turned a California desert that had grown nothing but cactus and thistles for centuries into the greatest fig-growing region in the world.

The hot sun and the dry air are ideal for this fruit, and the desert soil proved surprisingly fertile when irrigation was applied.



Turning water into the irrigation ditches in a plot of young fig-trees



A secondary screen, made in sections and rotated in front of the main screen, makes motion-pictures appear stereoscopic, that is, they stand out in relief from the background

Adding Perspective to the Motion-Picture

AN interesting experiment has been carried out on motion-pictures by a French scientist in which he has obtained some remarkable effects of depth without the employment of accessories beyond a unique screen. In his researches he discovered accidentally that if two positive views taken from the same negative and identical in every way are placed one on the other and viewed by transmitted light, the human eye distinguishes between the two views and produces an effect of perspective.

Further experimentation with this phenomenon brought out several ways in which the idea could be applied to motion-pictures. One method makes use of a rotating screen as in the illustration. This rotating screen, with the segments removed, is placed directly in front of the regular screen. By reason of the persistence of human vision, the spectator is made to see certain parts of the picture in more than one plane and the result is as if the picture itself had stereoscopic qualities.

The principal objection to this scheme, and one that would prevent its general use, is the fact that the audience must sit directly in front of the screen and at a certain distance from it, otherwise the distortion becomes so great that the effect of depth is lost. It is expected that further work along these lines will produce a screen or series of screens that will give the desired result without limiting the seating arrangement of the auditorium.

ALTHOUGH a falling barometer will invariably give warning of bad weather, the fall does not take place far enough in advance of the rain to be of much value. However, you can tell if the glass will rise or fall hours before the movement occurs.

If it is a mercury barometer, look at the top of the column. If level, the glass will be steady for hours. If the top of the mercury is concave, a fall is coming; if convex, a rise may be expected.

The information can be secured from an aneroid by watching the movements of the point of the indicator when the case is tapped lightly with the finger-nail. A jerk backward indicates a fall; forward, a rise.



A traveling crane mounted on a truck makes for mechanical efficiency in unloading barges along French canals. A fifteen-horsepower engine supplies power for crane and truck

Auto Crane for Barge Canals

THIS French automobile crane may give a hint of one way in which the United States may make its barge canals profitable. It has been cheap, if slow, to haul by water, but unloading has been so expensive that few business men use the canals, particularly at way stations, where modern handling equipment was altogether absent. This crane goes where it is needed, and will handle cargo as rapidly as any hoisting device of its type. The crane revolves in a complete circle on its base, so that material may be taken from the barges and loaded directly into trucks.

One engine supplies power to both the wheels and the crane. In unloading, the wheels are locked with the emergency brake and the transmission gears thrown into neutral. The gear-box is unusually large, and contains an additional set of gears attached to shafts operating the hoisting windlass and the turning mechanism of the crane.

The driver sits facing the rear. His right hand handles the lever controlling the turn of the crane, his left operates the hoisting engine. The pony brake-pedal is under his right foot, and his left is on the regular accelerator.

In cranes of this type the cargo is raised and lowered by the tackles. The boom is not moved except to adjust it to the proper height or reach. This is accomplished by a special gear-shift that throws a gear on the hoisting engine into mesh. The boom is then raised or lowered to the proper position by the regular controls. An engine supplies the power.

Elevators that Run on a Curve

ELLEVATORS usually travel perpendicularly, but those that connect the East



One of Boston's curiosities is an elevator that rises on a curved line. Hard-wood guide-shoes keep it level

Boston tunnel with the State Street station run on a curve. Owing to the narrowness of the street at that point it was impossible to build the station directly over the platform in the tunnel, a variance of six and a half feet being necessary.

The cars run on hard-wood guide-rails heavily backed by steel I-beams that are attached to the iron structure. There are guide-shoes at all corners that accommodate themselves to the curvature of the rails. The car floors are level at all times and the passengers are not aware of the peculiar path followed by the cars.

Each car—there are four of them—will hold fifty people and it will travel at a speed of two hundred and fifty feet a minute. The tunnel station is fifty-seven feet below the street level; thus the six and a half foot curve is a very gradual one.

Two somewhat similar elevators have been installed in the famous Eiffel Tower, Paris. The legs of the tower are curved and the elevators travel on curved rails a distance of four hundred and twenty feet, the height of the second platform.

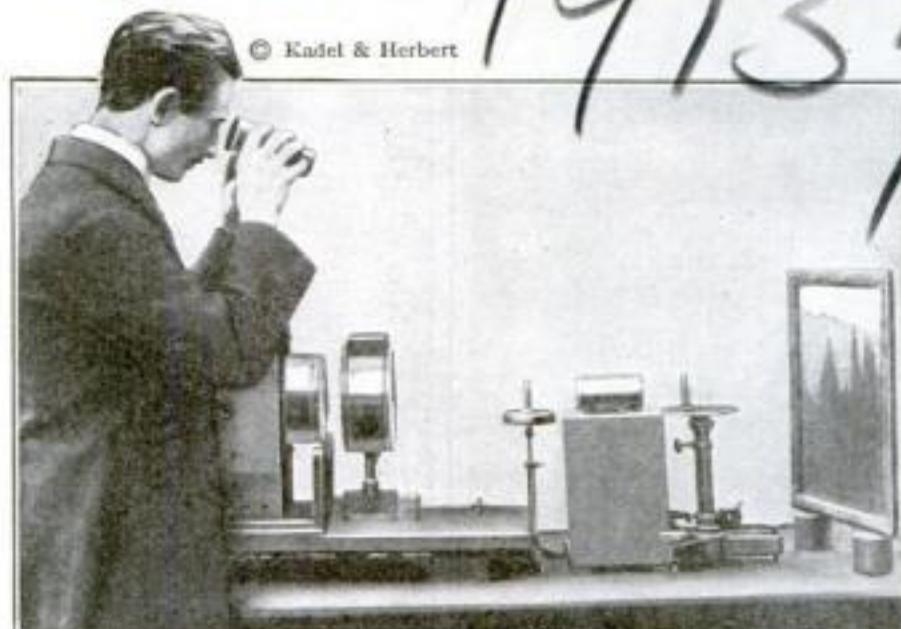
THE German alloy "elektron" contains 90 per cent magnesium by weight, but may be melted without danger of igniting in air as magnesium will. The metal has a tensile strength of from seven to nine tons a square inch, which is increased from eleven to fourteen tons by rolling or stamping. Elektron is proof against gasoline, acid free oils, grease and alkalis.

Polarized Light Reveals Original Work of Artists

WITH a tube that looks more like a telescope than anything else, M. Lambert, a Paris scientist, accomplishes what seem like miracles with the dingy works of old painters. He has taken paintings that have become darkened with the dust of centuries and with his apparatus has made them appear to the eye as though recently finished. Even the details that seem to have been lost are restored to all their original brilliancy.

The painting to be examined is illuminated by a powerful incandescent lamp or an arc enclosed in a lantern. The light passes through a condensing lens and then through a correcting lens, which makes the rays parallel before they pass through a tube containing a Nicol's prism, which polarizes them. After the light has passed through the polarizer, it is refracted by a diverging lens so as entirely to cover the painting to be examined.

A painting may be said to consist of two parts, the layer of



A highly illuminated painting viewed through a Nicol's prism is disclosed in all its original coloring

pigments and the coat of varnish that covers and protects it. The varnish turns dark with age and the light reflected from its surface interferes greatly with the light reflected by the pigments of the painting underneath the varnish.

When a painting, illuminated by polarized light from the apparatus described, is viewed through a single tube containing a Nicol's prism or through a binocular containing such prisms, it becomes possible, by turning the prism or prisms to the proper angle, to deflect the rays reflected from the varnish, permitting only the unpolarized rays reflected by the pigments of the painting to reach the eye or eyes.

In an exhibition given before the French Academy of Science, an old picture of a bouquet of flowers was marvelously revivified. The painting was old and obliterated, but under polarized light the flowers were seen to be roses and honeysuckle, resting in a dark-green glass bowl of water.

Print 1500 Photographs an Hour

THE professional photographer who prints negatives by the thousand needs a machine that will do the work quickly. The machine illustrated below has a capacity of fifteen hundred photographs in one hour. It prints from single films, uncut rolls, or glass plates. Shelves above the operating-table contain stacks of negatives, while pigeonholes at the right are intended for the various size sheets of photographic paper.

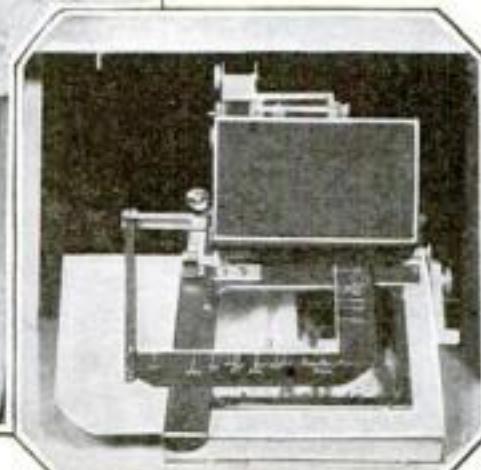
James Flynn, of New York, the inventor, has also devised a one-piece adjustable mask, which merely requires the turning of a thumbscrew to fit it to any width of border or any size print. There is also an automatic stamping device that changes the number with each print and stamps it upon the back as the print is being exposed

to the light. The type is of steel and is inked by a ribbon.

The light for printing is provided by four gas-filled incandescent bulbs of one-hundred-watt capacity. These bulbs are arranged to assure even illumination. The machine has a "double-break" contact switch that operates the amber or red pilot light and the printing light. When the paper has been slipped into the mask, the operator presses his foot on a foot-tread. This brings a felt pad down on the paper and turns on the printing light. At the same time the steel figures come down on the back of the print and stamp its number.



Pressing down the foot treadle will operate any one of the switches and at the same time it will number the prints



A thumbscrew is all that is necessary to adjust this mask to any size negatives



Floors, walls, and stairway are all of plate-glass. This is how a movie director obtained the illusion of fairy-land

A Plate-Glass Fairy-Land

A VISION of fairy-land was reproduced in the movies by a scene taken in a setting built entirely of plate-glass. Glass of five-eighths-inch thickness was selected. Working from drawings, a huge force of carpenters proceeded to completely cover a big tank and much of the surrounding studio space, building a floor. At one end of this platform glassworkers simultaneously installed a solid plate-glass stairway.

As soon as the platform was in readiness, other glaziers proceeded to cover the entire wooden floor with large slabs of more plate-glass. Plate-glass walls twenty feet in height were set in place along two sides of this "room," the stairway forming a third side, and the remaining side serving as a gateway for the cameras.

Beneath the transparent stairway a complicated system of lighting was installed in such a way as to provide a striking picture of flickering lights playing on the waters beneath the glass steps. Where the steps debouched on to the glass floor two wide shallow pools were constructed. Rising from the surface of these pools were eight octagonal glass pillars, each bearing upon its apex a large basket of blown-glass fruit over which the water from the enclosed fountains played.

It required two days and nights to film this episode and the whole vision will flash on the screen in approximately three minutes.

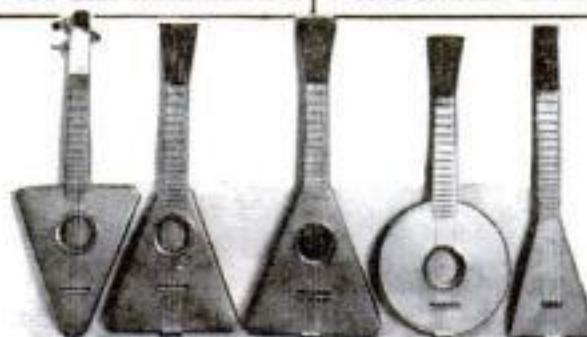


Giant Outdoor Reflectors for Photographing Movies

DID you ever wonder how the movies were able to take such sharp, clear photographs in the shade? Here is one of the secrets. A gigantic, flat reflector is being used to give the proper high-lights on the face of Corinne Griffith, who does not appear at all embarrassed by the juvenile audience at her love-scene.

With these screens the camera man can control the lighting effect out of doors as perfectly as in the studio. They are part of the regular equipment of some film-producing companies for pictures taken under the shade of trees, which are usually the despair of every amateur photographer.

The reflectors are made of galvanized tin to keep the light from becoming too bright. The reflection from a plate-glass mirror, like sunlight itself, might produce halation effects and would certainly destroy the illusion of shade when the picture was exhibited.



Ukuleles of Steel Will Withstand Hard Usage

AMONG the latest innovations are steel mandolins and banjos.

The instruments are comparatively inexpensive, since they are pressed out of steel, are as indestructible as anything can be, and the manufacturer claims their tone is excellent.

The instruments are light in weight, and should make a useful gift to young children learning to play, who would be almost certain to damage a mandolin of the usual fragile construction.

Bungalows Made from Discarded Street-Cars

THE housing shortage in Washington, D. C., during the past few years has produced some queer living accommodations. Here we have a family who considered themselves fortunate to get a couple of old horse-cars to serve as the nucleus of their bungalow.

The abundance of windows practically turns the entire dwelling into a sun-parlor. It is said that many houses of this type have been constructed along the banks of the Potomac.

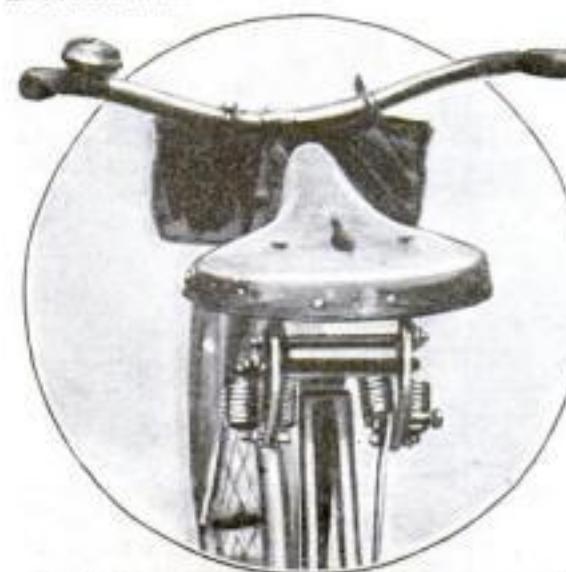
Besides saving lumber, the use of street-cars for side walls reduces the cost of building the remainder of the house. Numerous windows and complicated framing become unnecessary. It is reported that the cars were sold for their value as junk.



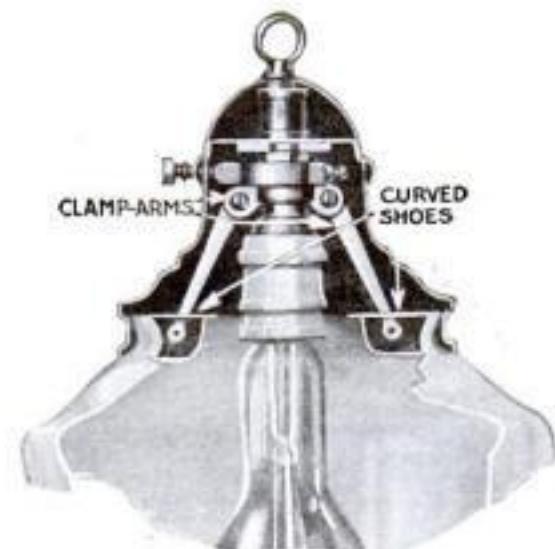
No More Telephone Headbands for Train-Despatchers

SINCE telephonic train-despatching has been in use, many of the men have suffered from ear trouble, some of it due to the pressure of the receivers and some due to static and other noises constantly occurring on the line.

The invention of a loudspeaker for train-despatchers will do away with all the drawbacks of the head receiver. This loudspeaker is composed of an audion amplifier, an electrodynamic loudspeaking receiver, and a voice-strength regulator. The amplifier allows the most distant station to be heard with clearness, while the voice-strength regulator tones down the voice from the nearer stations to any required volume.



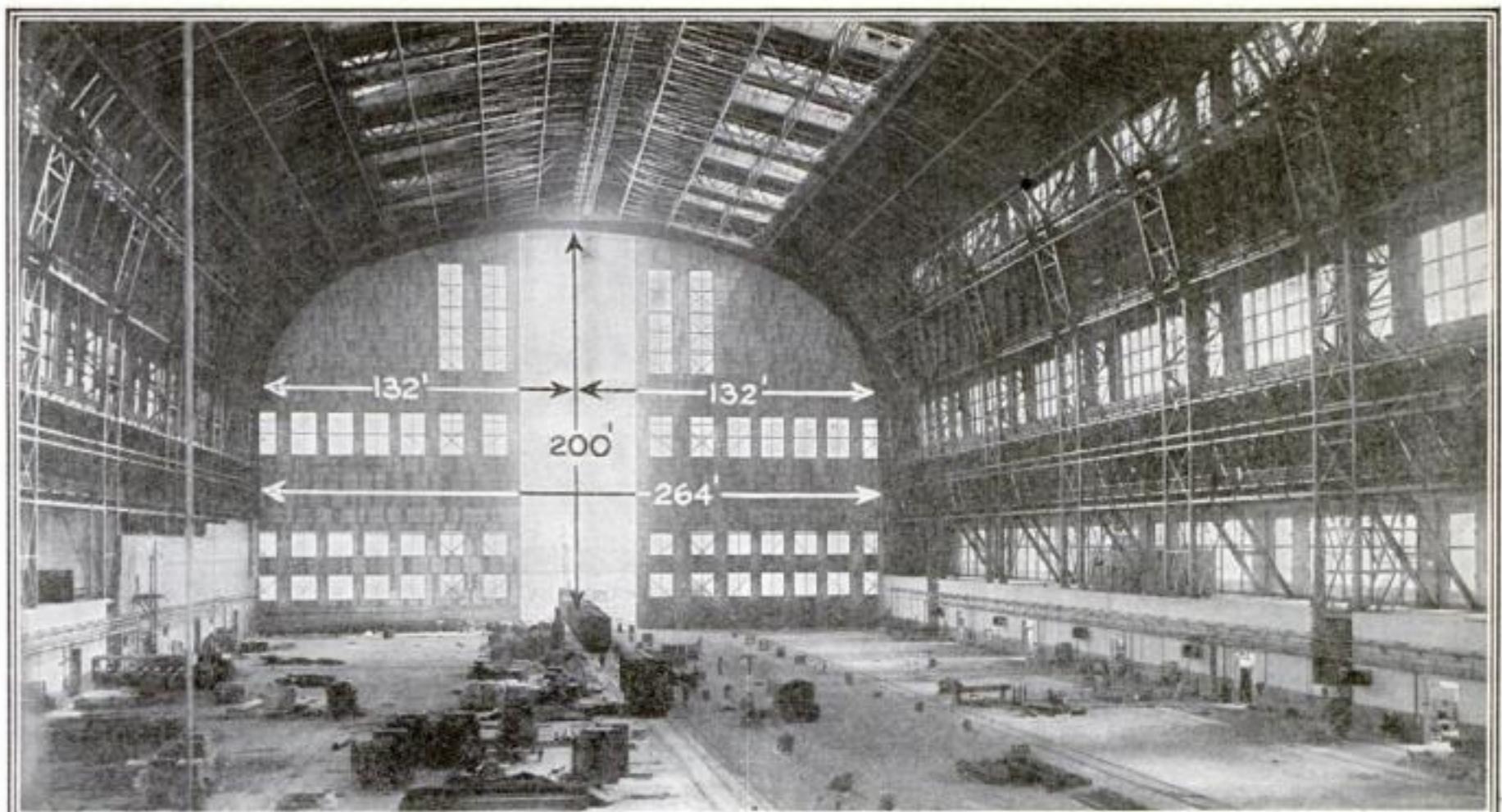
A tilting quadrant on springs supports this bicycle saddle at the back, resting on a lever bar in front



Holds Lamp-Globes Safely and Insures Quick Removal

HAVING two arms ending in broad, curved shoes which hold the lamp-globe by pressing against it outwardly from the inside, this new lamp-holder is said to be absolutely safe. Turning one knurled screw spreads both these arms apart until the globe is clamped between them and the rim of the fixture.

Contact is established all the way around the globe, whereas in the usual three- or four-point holder the few points of contact make the hanging of the globe uncertain, and unequal stresses set up by tightening one screw more than another often crack the globe when it becomes expanded by heat. This trouble is avoided with the new holder, which also permits quick removal by one man.



The Hangar that May Never Have a Tenant

THE huge hangar built at Lakewood, New Jersey, to house the ill-fated ZR-2 may never have a tenant. Whether or not the catastrophe of America's British-built dirigible will have a dampening effect on the further development of lighter-than-air craft depends on the governmental investigation of the accident. In the meantime the second ship of the same class, which was to be constructed in this country, remains unfinished.

This photograph was taken as the finish-

ing touches were being placed on the hangar. The shed has a height of 200 feet, a width of 350 feet, and a length of 807 feet.

Each of the four doors of the hangar weighs 1351 tons and is opened and closed by two 20-horsepower electric motors. All of the windows in the walls and roof are supplied with special amber-colored glass to prevent the entrance of ultra-violet light rays that would deteriorate the fabric of the envelope.

Several hundred feet away from the hangar is the hydrogen gas plant where the gas for inflating the big dirigible was to have been generated.

Whatever the findings of the board of inquiry as to the structural weaknesses that caused the disaster, it seems to be the belief of military and aero experts that since the dirigible has a definite place in wartime, its development must be continued, but perhaps along slightly different lines than heretofore.



This machine runs special cutting tests on brass rods to determine uniformity of material

Taking the Guesswork Out of Brass-Rod Cutting

TO insure that his brass rod shall be absolutely homogeneous and possess uniform cutting qualities, one founder runs a cutting test on every lot before it is poured.

Since cutting qualities of brass depend upon the accuracy with which the mixture of copper and zinc is maintained in the making, a small rod from every "mix" is cut in the special machine shown, and the mixture is changed until the indicator shows the desired cutting qualities.

Such careful testing proves its value in screw-machine work, where uniform toughness in the rod allows continuous high-speed output and reduces tool breakage to the minimum. The resistance of the test pieces is recorded on the dial of the dynamometer on a special lathe.

California Weed Causes Seventy Punctures a Day

SEVENTY punctures in one tire in a single day is the unenviable record of a California motorist who recently traveled through that section of the Golden State where the puncture plant is prolific and productive. Introduced as a stowaway in burs in the fleeces of imported sheep, the plant has become well established in certain sections of Arizona and California. It is responsible for 50 per cent of the bicycle and approximately 50 per cent of the automobile punctures that occur in these states.

Uncle Sam has been conducting a countrywide weed survey and has ascertained definitely that the puncture weed is spreading rapidly. The bur splits at



Puncture weed has five sharp prongs, any one of which will penetrate automobile tires

maturity into five sections, each equipped with a pair of bayonet-like spines about one quarter of an inch in length. These sections are scattered about on the ground in such a manner that one of the spines always points upward ready to puncture any inflated tire that passes over it.

This Portable Lamp-Guard Is Strong but Light



VARIOUS new features are embodied in this type of portable lamp. For one thing, its strength of construction will appeal.

A casing completely surrounds the lamp nearly to the base of the filament, and from this casing radiate flat guard strips around the lamp.

A special aluminum alloy is used for this metal, so that strength does not mean weight. A bayonet type socket is used. The wooden handle is easily removable and when taken off, it facilitates removal of the socket. There are no passages through which to thread the



Milk Aerator and Cooler for Small Farmer

THE milk aerator and cooler invented by Cyrus W. MacKenzie, of Waverley, Indiana, combines extreme simplicity in design, operation, and effectiveness in results. The inventor was a dairyman on a small scale, and found that cooling milk by dipping it up and pouring it back into the can aerated the milk and drove out the animal heat well enough, but took too much time.

The idea occurred to him that it would be quicker to force air in at the bottom with a pump and let it cool the milk as it bubbled to the surface. His chief difficulty was to devise a pump that would be perfectly sanitary and easy to wash.

His invention is essentially a simple pump that sucks in air on the upstroke, compressing it, and forcing it through the milk on the downstroke. It gives the small farmer the use of one of the improvements usually reserved for the large dairy, and as for ease in operation—the picture shows the simplicity of the machine, such that even a child could handle it.

Electric Iron Turned Upside Down Forms Stove



HOTELKEEPERS will consider the German who invented this electric iron for travelers an evil genius. In the first place, the iron cheats the house keeper out of pressing business and uses up current. The novelty is in the fact that it also may be turned upside down, the handle split apart as a rest, and a meal cooked on it. It comes packed in a handsome case. The whole weight is only about four pounds.

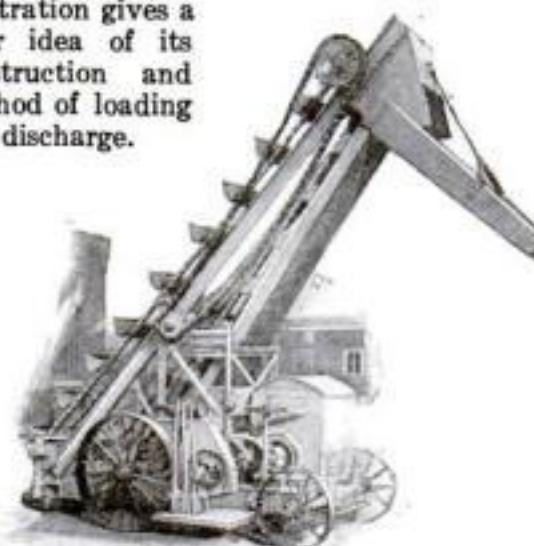
Endless Elevator Loads Truck in One Minute

BACK up your truck to the coal, sand, or gravel, pull a lever, and this truck-loading machine starts doing the work of four men.

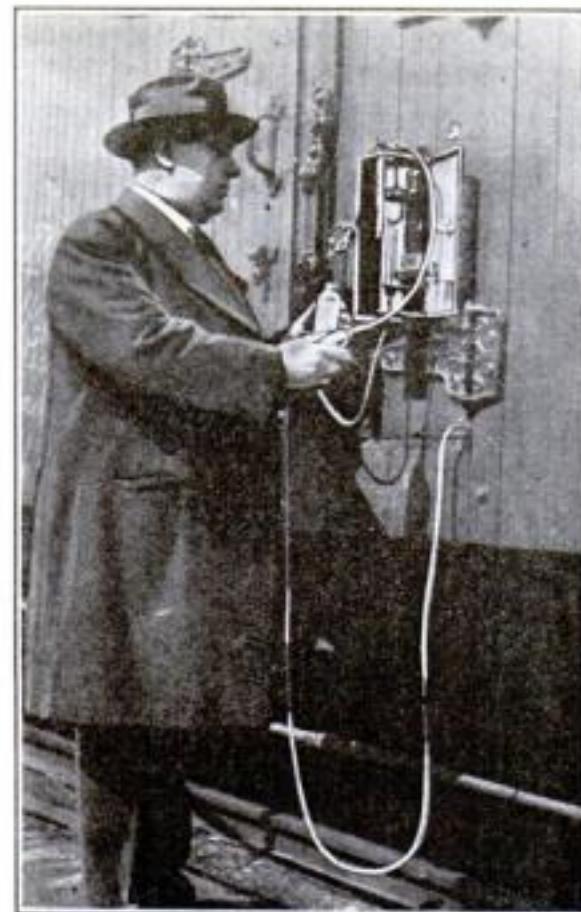
The elevator buckets, arranged on an endless chain, fill themselves at the feeding end and automatically discharge into a hopper at the top of the machine as shown in the picture below.

The self-feeding devices (operating like two large human hands) dig into the stock pile alternately, and pull in the material against the line of rotating buckets in such a way that each bucket receives a full load.

The machine can be operated with either a four-cylinder gasoline engine or an electric motor. When it is properly operated, this loader will handle more than a cubic yard of material a minute. It is unnecessary to go into fuller detail about this efficient machine. The illustration gives a clear idea of its construction and method of loading and discharge.



Two self-feeding fingers on this loader dig into the pile at the rate of a yard a minute



Testing the Breath of Bananas in Transit

IT seems that the popular banana continues to breathe after it is harvested, its respiration being greatest at night. The carbon dioxide excreted by banana cargoes in ships, trains, and fruit-storage houses must be constantly carried away by ventilating devices, for the sake of the banana's flavor and its preservation.

The device shown in the illustration on a refrigerating car, tests the inside air. Samples of the air are collected through rubber tubing, and the reactions on lime-water noted.

Graphite Sorted by Primitive Method in Ceylon

© Ewing Galloway



THESE Singhalese girls work so cheaply that no machine can compete with them, and about the only way to start a strike would be to insist that they do their work seated in chairs, for they prefer to work in the squatting position which would be impossible to a European. The group is engaged in sorting graphite.

Graphite occurs in isolated scales and veins embedded in the older crystalline rocks, chiefly gneiss, schist, and crystalline limestone, although the Ceylon deposits are found in granulite. The rock must be

broken into small pieces, examined for indications of graphite, and the culs thrown aside, much as slate is picked off of coal in a breaker.

The cheapness of native labor is shown by the fact that hammers are used to fracture the lumps instead of breakers, and that the sorting is done by scattering the lumps over the ground instead of placing them on a moving belt.

Graphite is found all over the world, but the greatest quantity comes from the island of Ceylon.

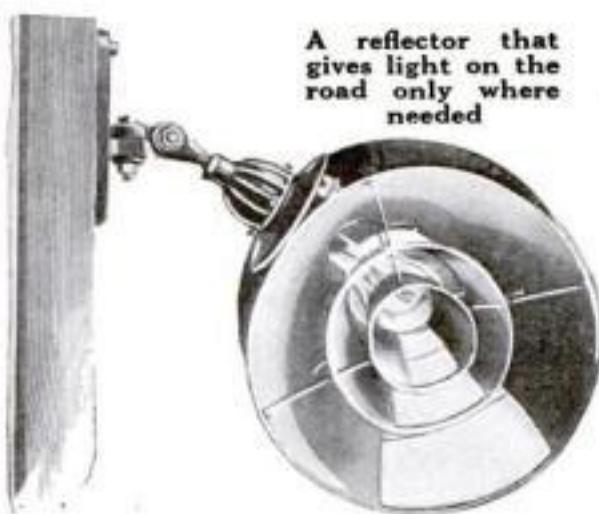
Importing City Lighting for the Country Road

EXPERTS declare that a large percentage of night automobile accidents can still be traced to the blinding glare of headlights, in spite of the improved headlight reflectors of many types that are being adopted. To eliminate mishaps from this cause, an experimental installation of highway lighting has been put up on Paradise Road, near Swampscott, Massachusetts. On entering this stretch, the motorist turns off his main headlights, since the road is lighted as brightly as Fifth Avenue.

If the experiment is a success, it is expected that the cost of such lighting improvements will be apportioned as part of the expense of highway work.

The light unit consists of a nest of reflectors, one within the other. Two of

A reflector that gives light on the road only where needed



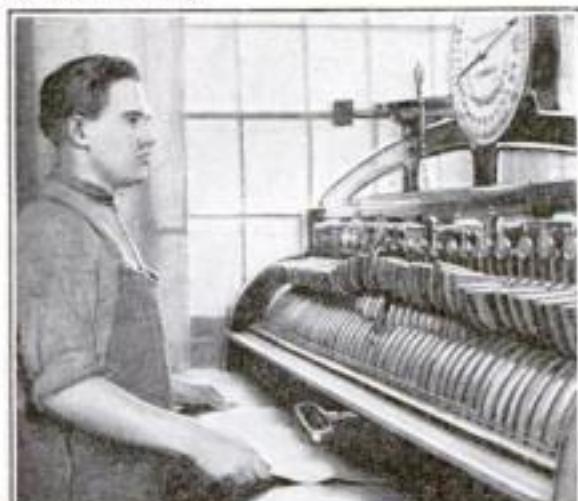
these direct the light toward the roadway at an angle of ten degrees below the horizontal. An opening just below the tip of the lamp also allows some light to be directly on the road immediately beneath the installation. The bracket holding the reflector is adjustable, so that the fixture can be mounted on poles close to the road, or on locations some distance away.

Machine Measures Leather Area

ILLUSTRATED below is a machine used to measure the area of hides. It will make allowance for the uneven edges of the skin, and will even subtract the area of a hole in the center of the hide. As the skin is drawn through the machine, the friction turns a series of wheels that will not move except when they are in contact with the leather.

The rims of the wheels are of known

© Kadel & Herbert



The hide is fed into this machine and numerous fingers follow the contour, measuring the surface

width and circumference, and it is comparatively easy to translate automatically into terms of surface area. Hides are sold by the square foot, and a machine like this is used to determine the amount to be paid.



Fire-Truck Helps Out in Water Famine

A THUNDERSTORM that burned out the motors of the pumping station at Clintonville, Wisconsin, totally cut off the city's water supply. In the emergency, a fire-truck supplied water service until the repairs could be made.

The truck, which was equipped with a

five-hundred-gallon pump, was located near the city well. A double line of hose was run to the pipe lines inside the pumping station, and although the water tower which can be seen in the background of the illustration is 164 feet above the pumping station, the fire-truck was able to fill it.

Gas-Bombs Reduce Rioters to Choking and Tears

There are no after effects from a dose of lachrymatory gas, but during its half hour of efficacy, it chokes and nauseates as well as produces floods of weeping.

The Smallest Ornamental Tree in the World

JAPANESE gardeners prune, starve, and potbind trees to dwarf them. Conifers are best liked for this development, as the hard woods are not so tractable.

The method of stunting is said to be secret, the heritage of certain families for centuries, but two explanations are offered. One, from Japan, is that the tree seed is placed in a half orange, its roots being clipped off when they bore through the skin finally being varnished and the bound roots placed in a pot.

An American arboriculturist suggests that the trees are propagated in high altitudes whose rarefied air produces stunted growth; strong pruning, lean soil, and pot cultivation also being resorted to.

Japan offers many varieties of dwarfs, but the popular kinds of these tiny trees are: bonsai, perfect miniatures; kengai, with long branches; nazaschi, with "weeping" branches; zikki, with geometrically arranged twigs; and neagari, with exposed roots.



A handful of the tear bombs that effectively dispersed the mobs

"TEAR-GAS" bombs with which various police departments are being equipped for use against rioters and unruly mobs, are the invention of Major Stephen De La Noy, of the United States Army. This is an application of a war device to peace-time uses.

During the war shells filled with lachrymatory gas were "sent over" by the hundred to make the enemy blind with weeping and distressed with coughing, choking, and sneezing.

Tear-gas bombs will not only check the advance of a wild mob and stop rioting, but will be invaluable in "smoking out" dangerous criminals barricaded in houses. With a puff of tear-gas near him, the worst of desperadoes is no longer dangerous. One little bomb may reduce the most hardened criminal to a weeping, cowering wreck.

Two hundred members of the Philadelphia police force were the first to experiment with lachrymatory gas. These stalwarts were organized into a rioting gang and were dared to rush past a given point, within throwing distance of five A. E. F. veterans. None of the cops got past the point, excepting those who rolled on in paroxysms of sobbing.



A stunted tree produced by the methods of Japan



Completely Automatic Car-Coupler

SIXTEEN years ago John Genin, of St. Albans, Vermont, set to work to make an automatic railroad coupler that would make it unnecessary for the brakemen to crawl under a car to connect the air and steam lines. Recently his invention was perfected and tested by the Canadian National Railroad, which endorsed it very highly.

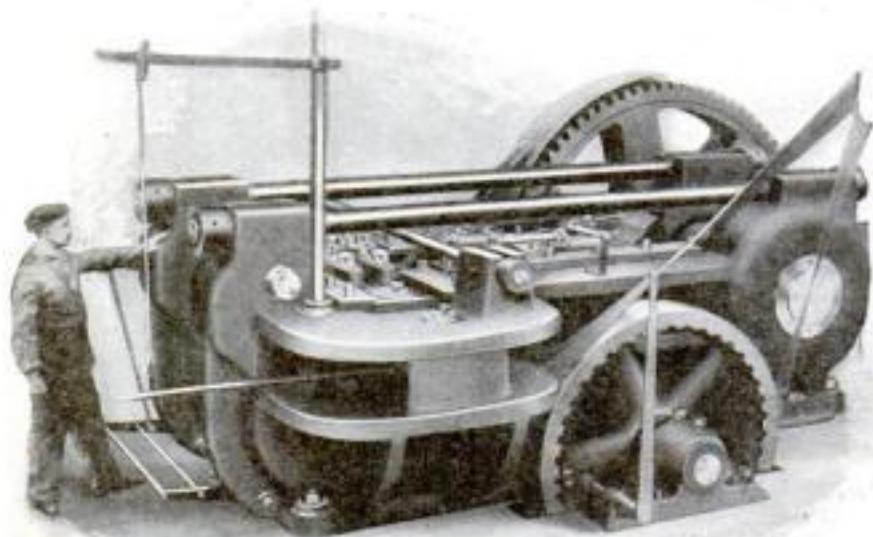
The coupler is an adjustable plate so constructed that a car equipped with an automatic coupler can couple up to one that still has the old-fashioned mechanism. It makes the connection of air-brakes, steam, and whistle lines all automatic and does not require the attention of any one during the process.

Horizontal Forge Press Economizes Space

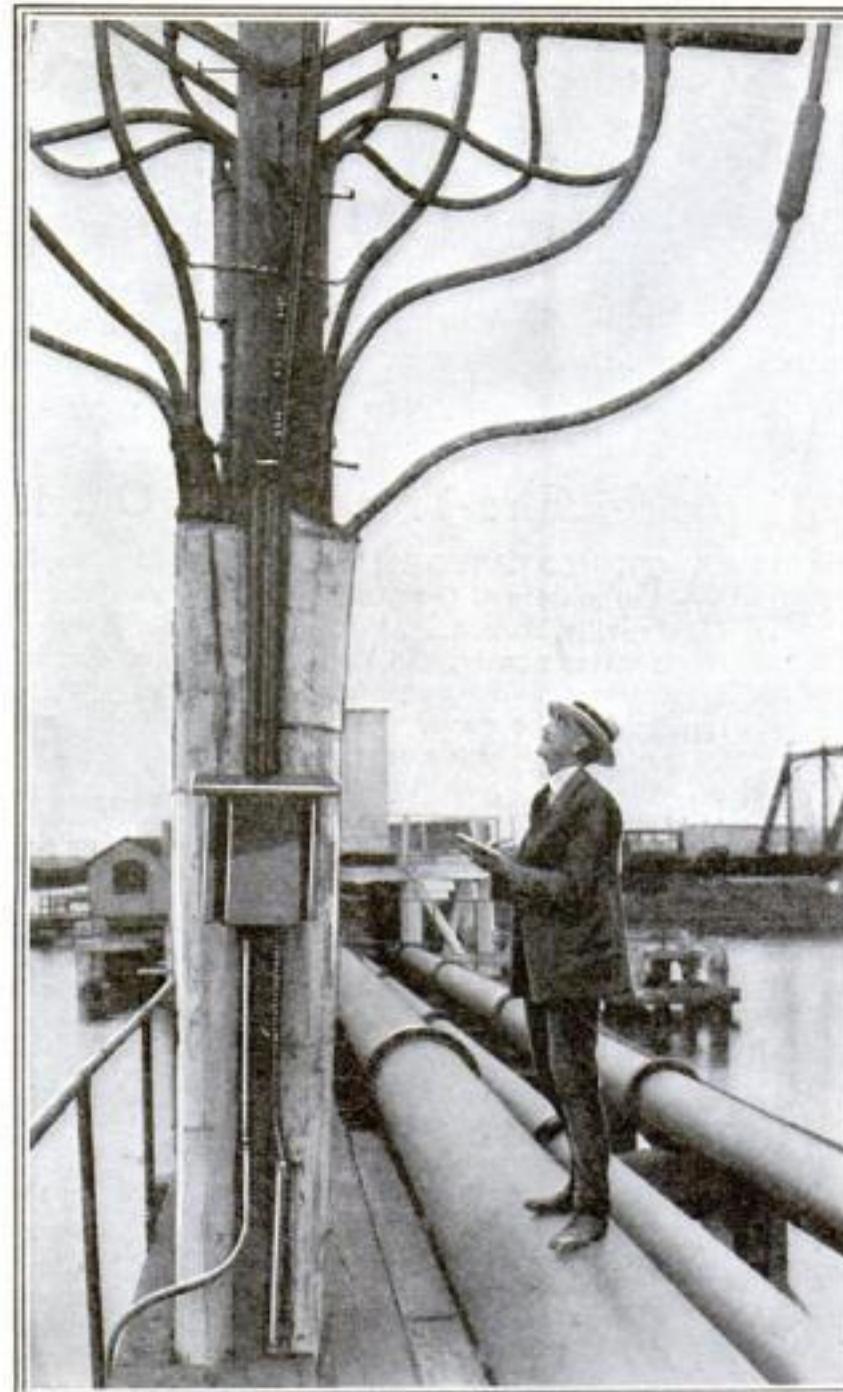
ONE of the features of this horizontal forge press is that it economizes in overhead space, which is sometimes a necessity and always an advantage in small works.

The soft metal in molds or matrices gets the full force of 10,000 tons upon it and the forge quickly turns out axles and similar products. Only the matrix need be changed for a variation in the forging.

This machine is proving a great success in Germany, where, it is said, novices are operating it. Many German mechanics were killed in the war and simple machinery is in demand.



The operation of this horizontal forge press is so simple that a mere novice is able to run it

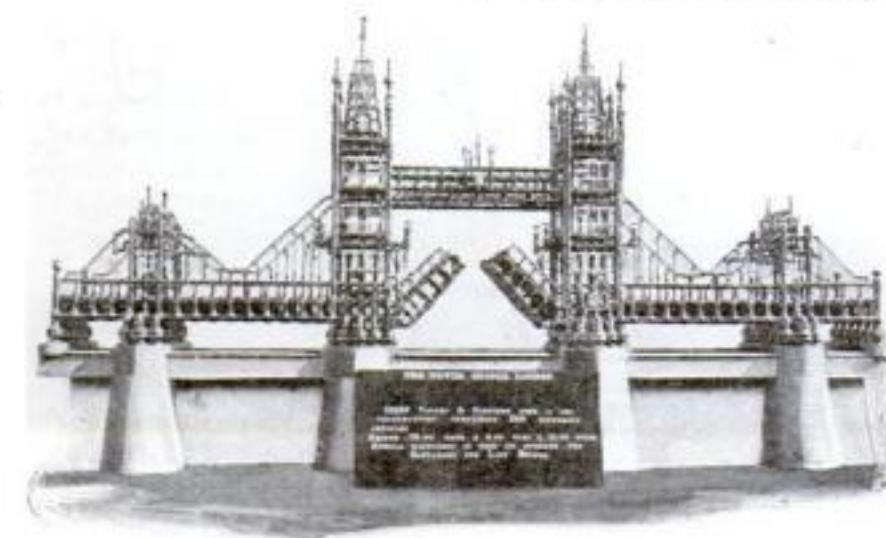


Inspecting High-Tension Pole Lines

AN inspector of high-tension wires must be able to walk over railroad-ties and other uneven places without lowering his eyes from the wires overhead. An error in judgment on his part—the neglect to notice a rotting cross-arm or a broken insulator—might involve the failure of this high tension transmission line, with a temporary ebullition of fireworks and subsequent darkness throughout the city.

There are some peculiar requirements for his work. He must be able to determine the condition of telegraph-poles at a glance, and have them replaced before they blow down in a heavy storm. He must be able to gage the rate of growth of various kinds of trees so that he can have them trimmed before they interfere with the wires.

Most difficult of all, perhaps, a wire inspector must remember every minor defect along miles of line, to avoid reporting the same breakage twice. His route is arranged so that the whole line is inspected at least once a week. Cracked insulators and warped cross-arms give the most trouble, as any electrician with telegraph wire experience will tell you.



Not one left-handed thread was used in this model of London's Tower Bridge



© Keystone View Company

A New Way to Bob the Hair

IT isn't the easiest thing in the world to cut hair so that it will hang evenly all the way round, but with the little guide shown above the hair is trimmed to the proper length. The device is an improvement over the traditional soup-bowl used by our grandmothers for this operation.

The guide is made of heavy cardboard, and can be cut out at home. It is a boon to the mother whose little daughter dislikes a trip to the barber's chair. Older girls who want to bob their own hair can do it in the same way, but to paraphrase *Punch*'s famous advice, the wisest counsel for those about to bob the hair is—Don't.

The Tower Bridge in Valve Fittings

THIS window-display model of the Tower Bridge in London was made of valves and fittings, with only a postcard view of the original for a guide. In it there are 15,358 pieces taken from regular stock, comprising 230 different kinds of elbows, tees, crosses, nipples, and valves, and 16,251 joints were used to make up the fittings. It is worthy of note that not one left-handed thread was used in the entire structure.

The model is approximately 19 feet long by 11 wide by 4 feet high. The draw can be raised and lowered, and the colored lights on the pipe model signal traffic exactly as do the warning lights operated on Tower Bridge.

1900 /

Primitive Methods Are Still Used by the Japanese in the Manufacture of Silk

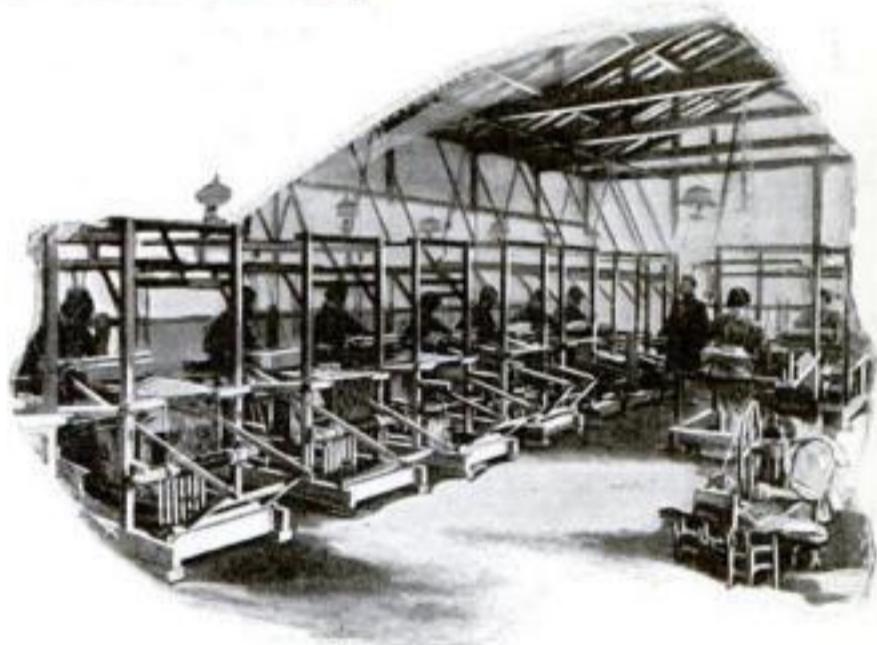
The boards in this illustration are covered by silkworm moths ready for mating. Each female moth lays from two hundred to five hundred eggs in the spring



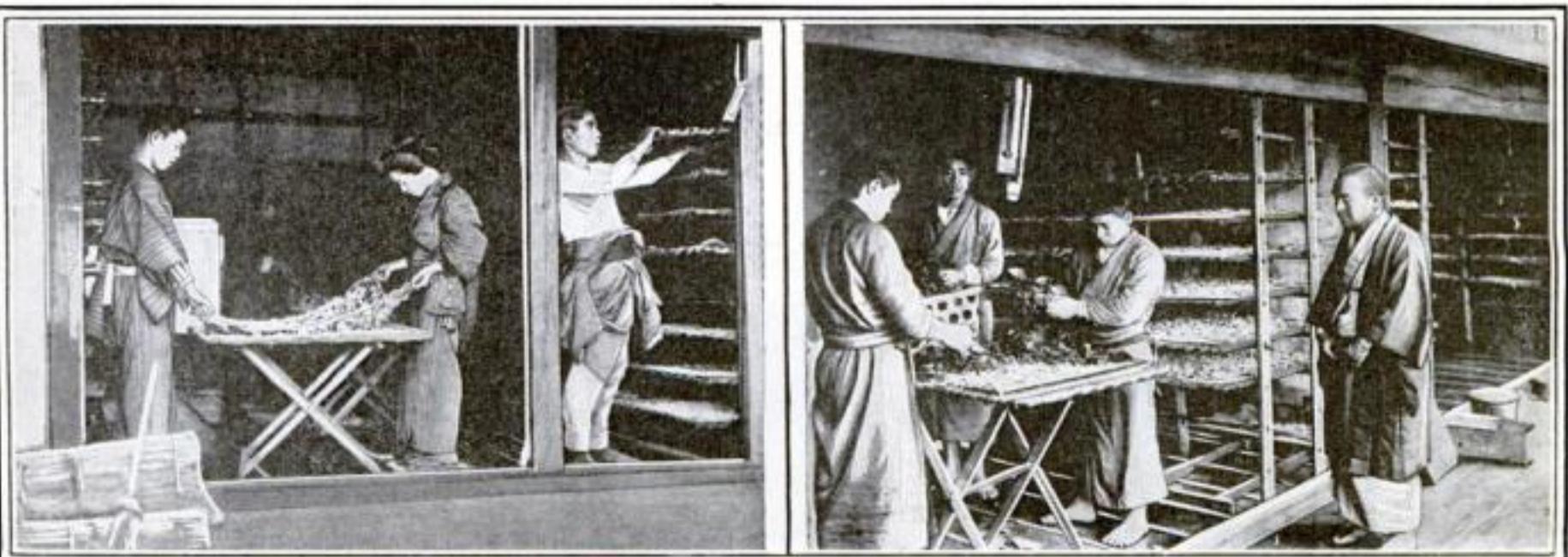
A corner in the silk-weaving room. These girls weave beautiful designs with the primitive foot-power looms, yet the high degree of dexterity demanded of the workers calls for a wage equal to about one fifth of what the similar task would bring in America



The completed cocoons are placed in a basin of water and then unwound on to reels. Close watch must be kept for uneven strands and strands partially eaten through



This picture shows the primitive machinery that Japan is content to use in its manufacture of silk. As a rule, the weaving is carried on entirely by foot-treadles



At frequent intervals during the life of the silkworm the beds on which they are placed must be changed. The man at the right is placing a bed of worms back on the storage shelf

Feeding mulberry leaves to the silkworms. The worms take about a year to hatch and after they emerge their appetites are unbounded. During their life they eat their own weight in mulberry leaves



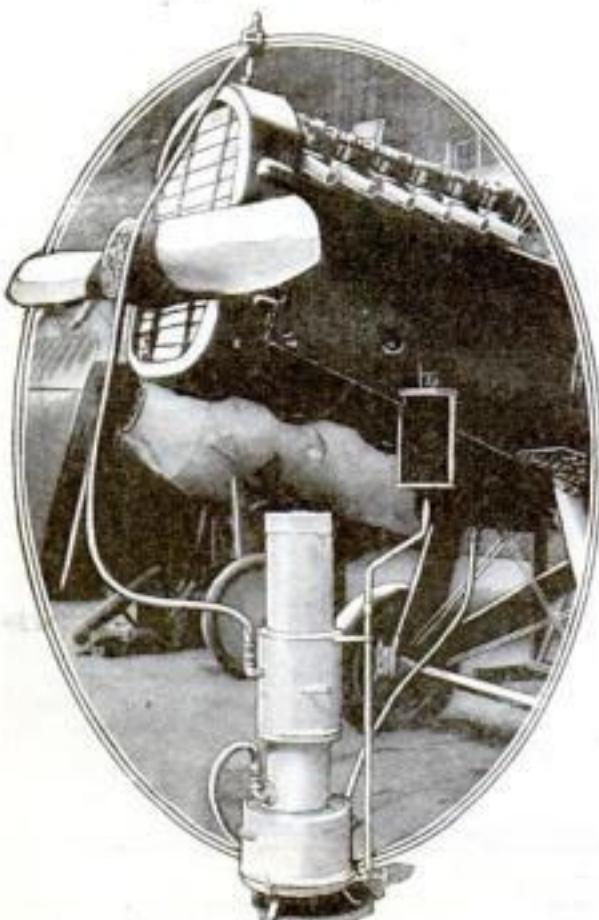
When a car of grain is to be sampled, this testing-rod is thrust down through the load. When withdrawn, the compartments are filled with specimens from different levels.

Grading Wheat in Carload Lots

HUNDREDS of tests by the Federal Bureau of Markets prove that there is a vital relation between the grade of wheat and the yield of quality flour that can be milled from the grain, but it has been difficult to the point of impossibility to locate a small pocket of low-grade wheat hidden somewhere in the contents of a loaded freight-car. This trouble has been overcome by the invention of a sampling-rod that enables wheat to be taken from every portion of a carload in a short time, and by running a test of samples taken from fifty different points, the investigator can get a reliable idea of the average grade of wheat in the car.

The grain probe has ten compartments, independent of each other, which are opened and closed by turning the handle after the probe has been plunged into the grain. Five probes are made and the samples placed on the cloth. Dirty or faulty wheat loaded in any portion of the car can be easily discovered. If none is found, the cloth is folded from the four corners, which thoroughly mixes the samples, and the grade of wheat is then determined. Thus the Bureau of Markets can determine the quality of the entire carload by one test. Farmers get a better price for clean wheat, and where these tests are in use, they find it profitable to store the grain carefully.

Keeps Airplane Engine from Freezing



This simple heater keeps the airplane engine from freezing by circulating warm water through it.

COLD weather no longer has any terrors for the airplane owner whose hangar cannot be heated in winter. An airplane engine-heater, tested by the Army Air Service, that maintains a constant circulation of hot water for twenty-four hours will keep the radiator from freezing.

The stove consists of a twenty-four-inch vertical coil of three-quarter-inch copper pipe surrounded by a sheet iron jacket; a burner in the base, two fire-screens, a fuel tank, gasoline feed-pipe and connections; and inlet and outlet water-pipes from the oil to the top and bottom of the radiator. The circulation is thermosiphonic. The burners require a pint of gasoline an hour. Care should be taken in lighting the stove, and the fire-screens above the burner must be kept clean, for soot deposited at this point is liable to cause trouble.

In starting the stove, the feed-pipe is filled with gasoline, the tank put on, and the main burner valve slowly opened. The "gas" then fills a cup. When nearly full, the burner is closed, the fuel in the cup lighted and allowed to burn out. Then the main valve is again opened, at the same time lighting the burner with a match. The door of the heater is tightly closed and the valve at the bottom of the supply pipe is then put at a quarter turn. The stove will burn without attention until the fuel is exhausted.

The Tire Is Inside the Rim

BASED on an entirely new principle, this patented automobile wheel carries its pneumatic tire inside the rim, where it cannot be punctured or cut. As the illustration shows, the new wheel consists of an outer tire of solid rubber on a flexible metal rim supported by a small, fully inflated pneumatic tire attached to a



The inflated inner tube serves as a cushion for the outer rim



A steel disk covers the wheel, keeping dirt and oil from the inner tube

second rim bolted to the hub. In service the whole wheel is protected by a metal cover that guards the tire inside even against dust and sunlight. The inflated tire "rides" in fork-shaped grooves that connect it with the outer rim.

The inventors claim that this arrangement combines the wearing qualities of the solid rubber tire with the safety and comfort of the pneumatic. It was developed for use by trucks over rough roads that cut pneumatics to pieces. Creeping has been eliminated, and as the inner tire never comes into contact with the road, it will hold its air for a long time and wear almost indefinitely. The outer rim is made of steel and is sufficiently flexible to keep from being permanently deformed or dented by the shocks of driving over rough roads. The weight of the car is borne by the forks, and is supported by the inflated tire.

Roller Coaster Built by Children

The track is uneven and the car insecure, but the boys who built this roller coaster get more fun from it than if it were perfect



THREE of the cleverest boys living on the East Side of New York City conceived the idea of making their own roller coaster from odds and ends found in back lots. The enterprise fitted into the imaginations of other youngsters and soon boxes and boards were collected in sufficient quantity to construct the coaster.

As completed the coaster is two hundred feet long and runs down the natural slope of a hill. A packing-case mounted on roller-skate wheels serves as the car. The track is not smooth, but that only adds to the exhilaration of the slide.

It is not uncommon for glassblowers to drink from twenty-five to thirty quarts of water in the course of a day's work, but history mentions a baby of three who used to drink two pailfuls of water a day. She grew up, apparently quite healthy, gradually increasing her quota to four pails.

Mutilating Plants to Make Them Grow

FRUIT and flowers are worth more than wood—so English botanists cut rings in the bark of trees in order that more of the nourishment rising from the roots may be diverted to the fruit.

A shallow ring is cut with a sharp knife just through the outer layer of the bark. Great care is taken not to cut into the



Deliberate mutilation of plants increases their growth and productivity

wood, for this would kill the branch. The cut is then bandaged. The result is that the sap cannot be absorbed by the bark, but passes on to the buds. At the Ashton Experimental Station in Bristol, England, it has been proved that in skilful hands this treatment makes the bark thinner, and greatly increases the size of the leaves and the productivity of the tree.

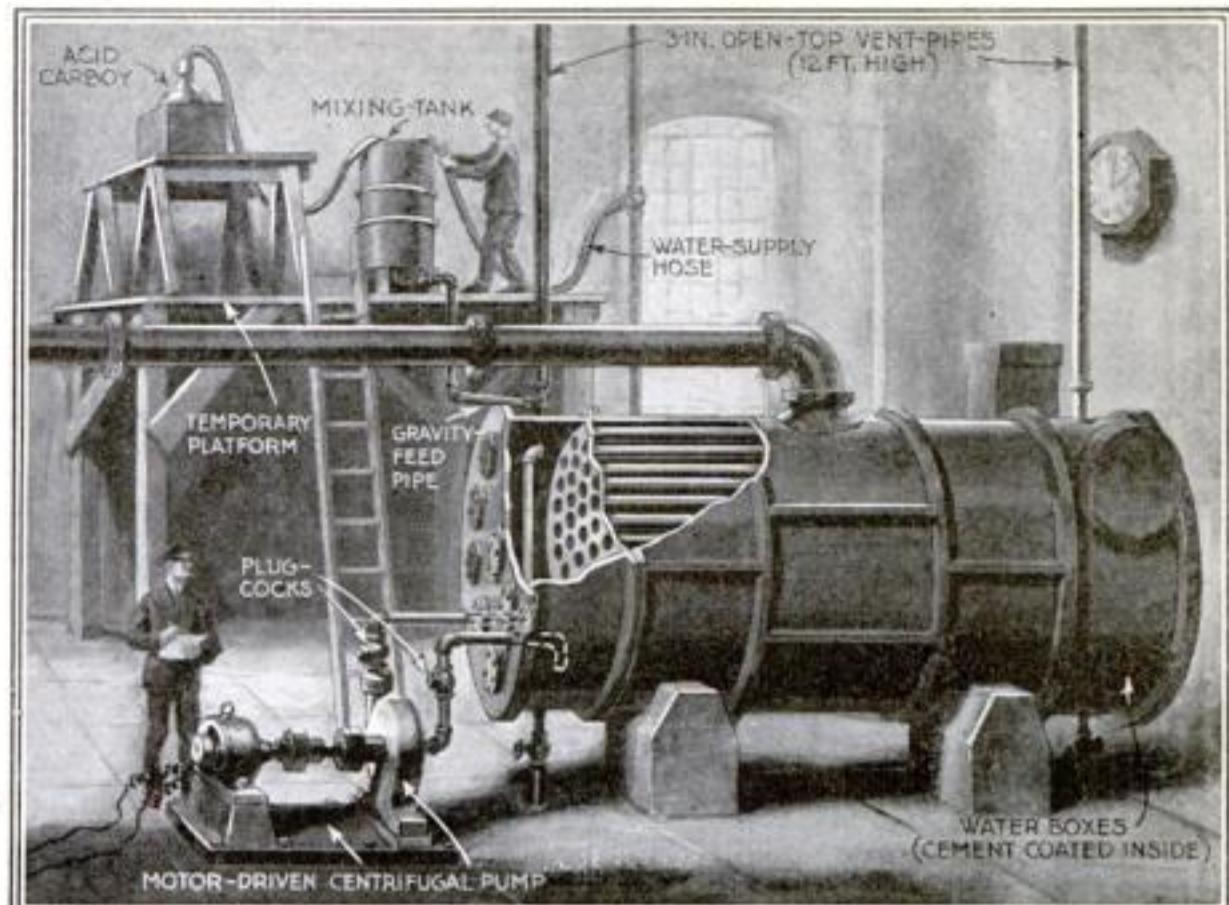
This Oil-Tank Was Moved Nine Miles

TWO hours and fifteen minutes sufficed to move this water-tank from Engle to Cutter, New Mexico, over the tracks of the Santa Fé. The tank is 45 feet high and 24 feet in diameter, and weighs 65,000 pounds. The difficulty of the job was increased considerably by the fact that there are two one-degree curves in the tracks over which the tank passed, in both of which the outer rail is slightly banked, the elevation being two inches in one curve and two and three quarter inches in the other. Great care was necessary at these points to prevent the tank from swaying and overturning.

The tank was cut from its concrete base, raised upon jacks, and a spur track built beneath it. It was then lowered upon a flat-car, which was strengthened by bridge-stringers placed lengthwise on the floor. To prevent swaying, this car was then securely fastened to another car loaded to capacity with broken stone.



This twenty-four-foot oil-tank, forty-five feet in height, was hauled nine miles over a railroad track of ordinary width at the rate of four miles an hour



A 3 per cent solution of hydrochloric acid forced through the tubes of surface condensers effectively loosens the boiler scale and makes a comparatively inexpensive job of cleaning the boilers

Hydrochloric Acid Removes Boiler Scale

A POWER-DRIVEN mechanical cutter is usually employed to remove scale from the tubes of surface condensers. It is admittedly not the best method, for in addition to the expense of the operation, tubes are liable to be broken; but engineers hesitate to use a dilute solution of hydrochloric acid, in spite of the theoretical advantages of this process, because they fear the possible action of the acid on the metal parts of the condenser and tube packing.

In the opinion of Norman C. Hardy, chief mechanical engineer of the Arizona Copper Company, this danger may be overcome. He has used acid for cleaning con-

denser tubes for two years with excellent results by the method illustrated in the illustration. He calculates the saving effected in cleaning a 7600 square foot condenser amounts to \$893.41 over mechanical methods.

A 3 per cent solution is pumped through the condenser from four to five hours, after which the loosened scale is washed off with a wire brush and a hose. To protect the metal parts, the water-boxes, heads, and tube sheet are first cleaned mechanically and then painted with two coats of roofing cement. Cover plates and gaskets are next fastened over the water inlet and outlet, with capscrews tapped into the water-box. The heads are then replaced and the apparatus connected up as indicated above.

A two-inch brass centrifugal pump with a directly connected motor drive is used to circulate the solution.

Caruso Candle Will Burn in 6921

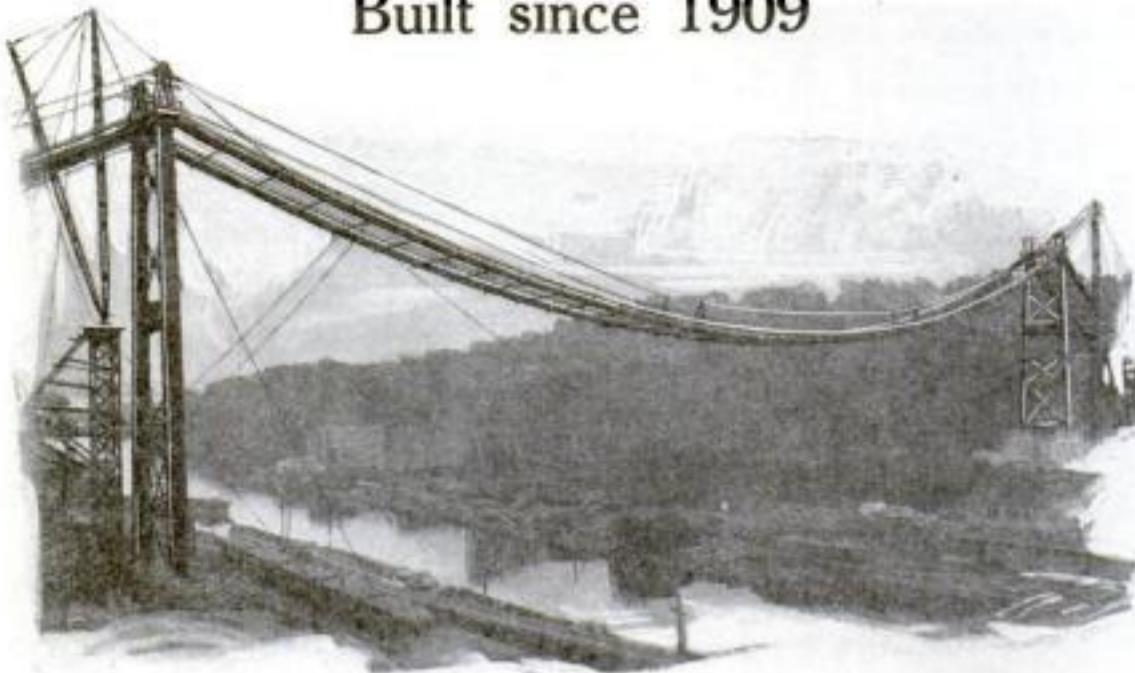
A CANDLE weighing a thousand pounds, that will burn twenty-four hours every second day of November for five thousand years is a memorial to Caruso that will be presented by Italian orphans in New York City to the Church of the Madonna di Pompeii, Naples.

Caruso was born in Naples on November the second. This candle will burn 120,000 hours consecutively, or for almost fourteen

years. The figure of Christ will be modeled in wax on the candle's base, and the name of every orphan contributor will be imprinted on the stem. The wax was contributed by the candle-makers, Antonio Aiello and Brothers, of New York.

This memorial is a grateful acknowledgment of the singer's contribution of ten thousand dollars a year toward the support of the orphan asylum in New York City.

The First Large Suspension Bridge to Be Built since 1909



In building a suspension bridge, a temporary pathway is first strung across for the movement of workmen and the wire-stringing machine

SPANNING Rondout Creek, a tributary of the Hudson River at Kingston, New York, is the first large suspension bridge to be erected in twelve years. The last one of any consequence was the Manhattan Bridge over the East River, New York City, which was built in 1909.

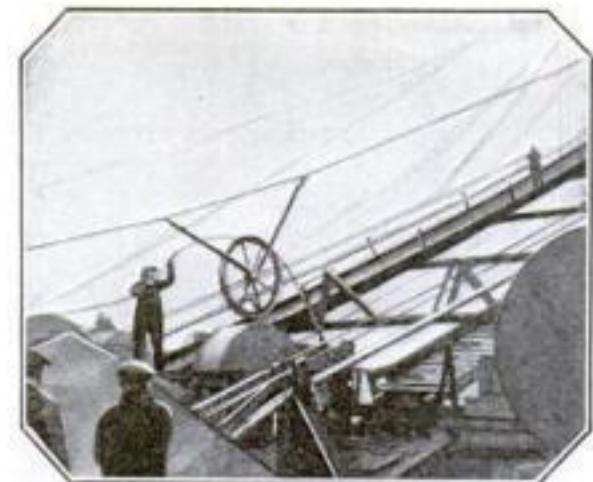
The Kingston bridge is made up of two towers, 168 and 185 feet high respectively, from which cables 1185 feet long are hung. The length of the roadway is 1145 feet, with a clearance of eighty-five feet above the stream. Dropping from the cables are the "suspenders," which support a concrete roadway twenty-two feet wide and a footpath seven feet wide.

The supporting cables were built up in place, two strands at a time. Large reels of hard-drawn steel wire, three sixteenths of an inch in diameter, were placed at each corner of the bridge and the free ends fastened to the anchorage shoes. A revolving wheel of an endless moving cable, shown in one of the illustrations, was then slipped in the bight of these wires and drew them across the bridge gap over the improvised suspension path. On the opposite

shore the loop of the wire was attached to the anchorage, and the traveling wheel sent back carrying a bight of wire from the other reels.

This operation was repeated until fourteen ropes, each containing 282 wires, had been built up. More than 913 miles of wire was consumed. After the cables were completed they were lifted into place in their saddles on the tops of the towers, and carefully adjusted until their sag, or versed sine, was the same as that of a guide wire. At this stage the cables consisted of a loose bundle of parallel wires.

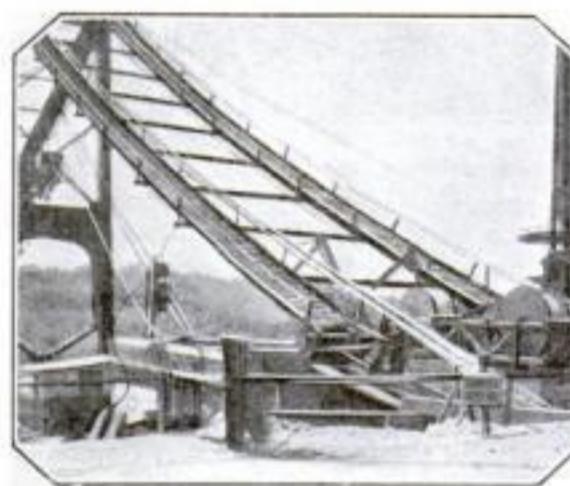
After the engineers had satisfied themselves that the sag was correct, and that the strain on every strand was the same,



With one end of the wire anchored, this traveling wheel carries one loop across to the other shore and returns with another

the cable was compressed in a powerful screw clamp with a circular opening which forced the wires into the form of a round rope. They were then wrapped concentrically with steel wire, as a whipping is put on a fishing-rod. An electrical winding machine was used to put on this whipping with the requisite tightness. The last step in the construction was to clamp the suspenders over the finished cables, and erect the steelwork and the roadway in the customary manner.

It would be quicker and easier to form the cables of suspension bridges out of twisted wire ropes, but for an equal weight and diameter a cable of parallel strands is at least 10 per cent stronger. It is also easier to detect and cut out any imperfections in the wire when it is built up strand by strand. In spite of this apparently slow process, the Kingston bridge will be finished in less than a year. The cornerstone was laid in December, 1920, and it is expected that the bridge will be ready for traffic any day.



A near view of the pathway, with the wire reels showing at the extreme right

Plastometer Reads Person's Ability from Contour of Head

THE young woman in the illustration, with what appears to be a combination sextant and double telephone receiver clamped to her head, is having her inner and outer self measured. A Berlin artist, Dr. Burger, having become intensely interested in phrenology, along with his passion for modeling, invented the "soul and body caliper," which is called a plastometer. It is said to register scientifically the meaning of every cranial depression and protuberance in calibrated degrees of physical and mental weaknesses and powers, and inherent intellectual and manual proclivities, with a sureness that would require months of observation by any other method heretofore known.

It is said that the face and head comprise a human dial, which the plastometer can interpret with unerring accuracy. One bump tells whether you are musical, another if you are combative, another if you have great

linguistic faculties. These bumps have long been known to phrenologists, but they have never been able to make readings with the precision of the plastometer.

And Dr. Burger goes further than the manual phrenologist by reporting that signals in the surface of the cranium warn of approaching disease and incapacity.



The bumps and hollows of the patient's head are revealed and translated by this strange-looking instrument called the plastometer

NATIVE American weeds might produce three hundred million pounds of rubber a year if it were commercially profitable to exploit them. Dr. H. M. Hall, who has been investigating possible sources of native rubber, believes that the common milkweed and the aster family of plants both produce a rubber sap. The *Chrysanthemum nausseosus*, or rabbit plant, is a promising species that might be used for a source of rubber of excellent quality in case emergencies should close the usual channels of import.

Pumping a Million Tons of Coal from River-Beds

Susquehanna River takes coal rejected from mines and makes it better than colliery's best

THE Susquehanna is the world's champion "coal-bearing" river. It bears this coal not in strata, but in the lumps and dust that are ejected from Pennsylvania's great anthracite mines. This is "reject" coal, and it is estimated that the rejects from the 350 principal collieries in the state amount to nearly 500,000,000 tons a year, much of which is dumped into streams of various sizes that pass the mines.

Now here's where nature jeers at the miner. It accepts all this anthracitic waste in its rivers and promptly proceeds to carry it downstream. In the stream-conveyance it bumps this coal about. The operation has come to be technically known as "jiggling" or "riffle-washing." When the waste coal has been jiggled for from fifty to a hundred miles, it is found to be a much better fuel than coal fresh from the breaker.

Besides rebuking man for his wasteful methods, nature also transports this enormous bulk of millions of tons of coal, free of all cost, to great mill centers, where its easy extraction cheats the collieries out of the sale of their rail-transported product.

The method of mining this dump coal from Pennsylvania river-beds is by the use of ordinary sand-pumps and clamshell dredges. The pumps and dredges discharge on a screen which permits mud and sand and water to filter back into the river, but retains coal.

Thirty-three years ago "river coal" was first extracted by a sand-pump with the idea of its being used. But it was rejected because of its high ash content.

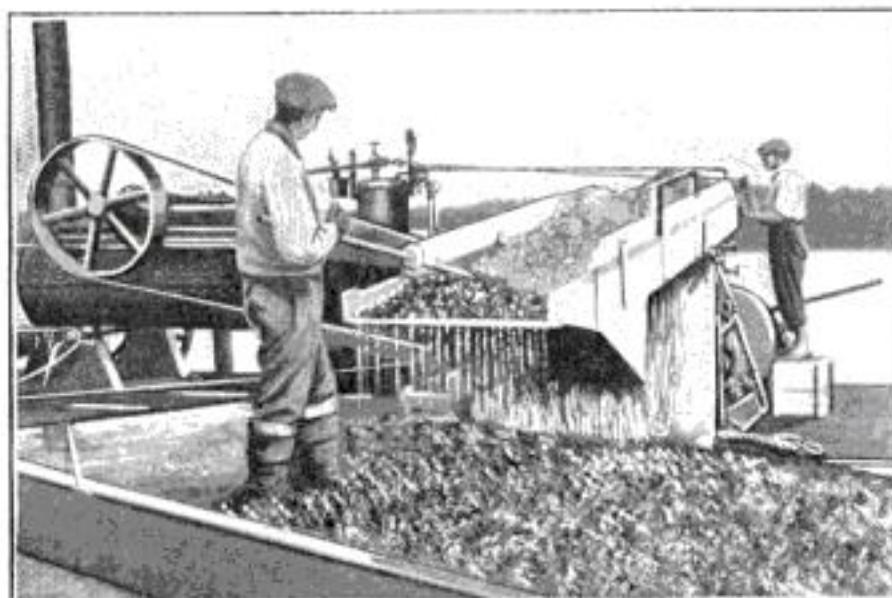
In many intervening years "river coal" was sold by a few sand-pump firms for from fifty to sixty-five cents a ton, sometimes even lower, the buyer doing his own hauling. Then a state geologist became interested in the slowly growing coal-pumping industry and made tests.

Coal pumped from the Susquehanna at Harrisburg averaged from 15 to 18 per cent in ash content. The same anthracite from the colliery breakers had from 18 to 30 per cent ash content. The dump coal had turned out to be better fuel than the quality grades fresh from the mines! Volume for volume, it was higher in thermal units than accepted coal—just because it had been dumped into a river and allowed to jazz downstream!

An average analysis of river coal showed this splendid composition:

Moisture.....	3.42	per cent
Volatile matter.....	7.95	" "
Fixed carbon.....	73.11	" "
Ash.....	15.52	" "
British thermal units.....	12,250	

There was a quick right-about, of course, and a big market was at once opened for river coal. During the years of 1919 and 1920, the yield of coal pumped and dredged from Pennsylvania river bottoms was more than two million tons for each



Huge pumps operated from flat-bottomed scows lift up the wet coal from the river bottom and deposit it on a screen, which allows the mud and sand and water to sift through the mass, leaving only the pure coal, which is much higher in thermal units than coal taken straight from the mines

year. The Susquehanna and its tributaries had the greatest yield—1,586,000 tons for 1919, and approximately the same amount for 1920. At Harrisburg alone 400,000 tons are being extracted yearly. A little creek called the Shamokin is yielding 750,000 tons a year; 235,000 tons comes from the Schuylkill, 120,000 from the Lehigh.

A state geologist poking around in the little Shamokin creek, found one bed of 2,000,000 tons, a thousand feet long and ten feet deep. He mentioned this casually in a recent lecture before Philadelphia coal experts to convince them that

the yield of river coal is by no means being exhausted.

Pessimists have said that the supply would last only from four to ten years longer—this term depending on the degree of pessimism. But other experts reply that there are not only twenty-five to thirty million tons still resting in the riverbed, but that the dumping is continuing at the mines.

Before the pumping and dredging of the coal had become a great industry, the waste coal cost the mines a great sum in

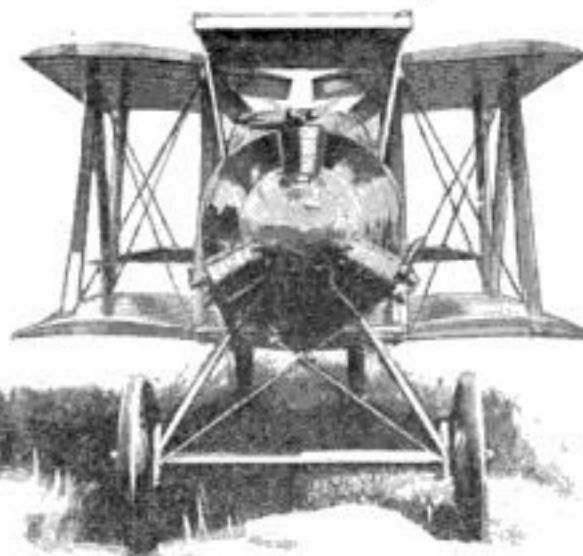


These coal-pumping dredges are reclaiming millions of tons of low-priced reject coal annually

yearly indemnities to farmers. The riverbeds were filling up with coal, and during the rainy seasons overflows were frequent.

However, farming land is no longer spoken of as being ruined by the anthracitic sediment. Instead, railway-tracks have been laid out on these flats and the silt is shoveled into coal-cars as soon as a providential flood comes along.

Farmer's Airplane Rises from Barnyard



With wings folded back this five-hundred-pound plane takes up no more room than an automobile

BUILT with wings that fold back against the fuselage so that the plane may be stored in a Ford garage or any barn that will house a two-horse wagon, this new machine, designed by A. K. Longren, of Topeka, Kansas, may prove the Ford of the

air. It is one of the smallest practical airplanes ever constructed. The total wing spread is about nineteen feet, and when folded it measures only nine feet wide, seven feet tall, and nineteen feet long.

To prove that the ability to fold the plane was not gained by any sacrifice in strength, on its initial flight this plane was put into two tail spins, twelve loops, and a barrel roll, which shows that its wings are as strong as those rigidly connected to the fuselage. Although the plane weighs only five hundred pounds, it will carry a useful load of the same amount and is equipped with a sixty-horsepower motor.

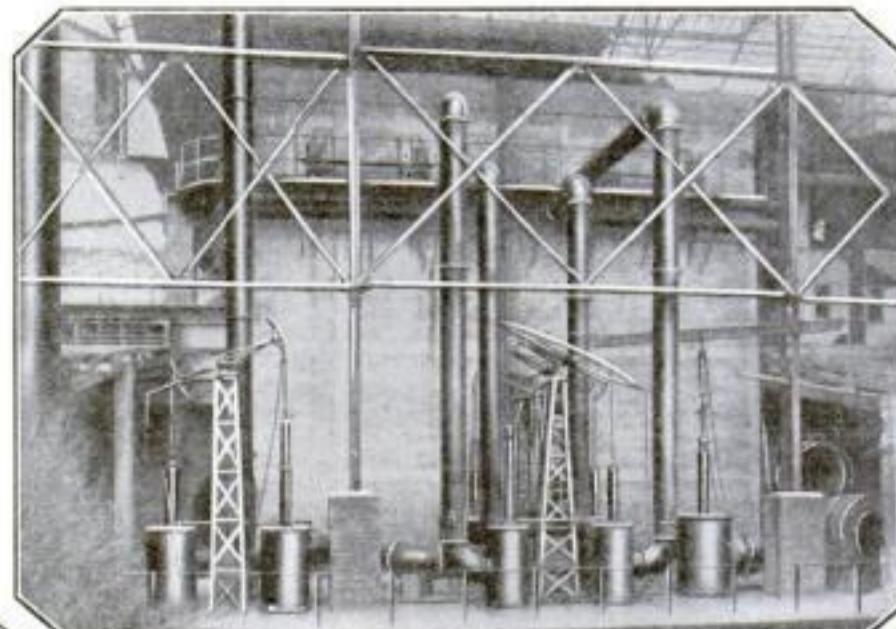
Its outstanding feature is its ability to take off and land in confined spaces. It will leave the ground after a run of 125 feet, and land in seventy-five feet, so that it may be brought down on a field of ordinary size, and is independent of elaborate landing-fields and hangars. This makes it an ideal machine for farmers and professional men who are awake to the advantages of the airplane for inspection trips, patrolling forests against fire, and for long flights to examine property far from ordinary lines of communication.

Basset Process Makes Steel Direct from Ore

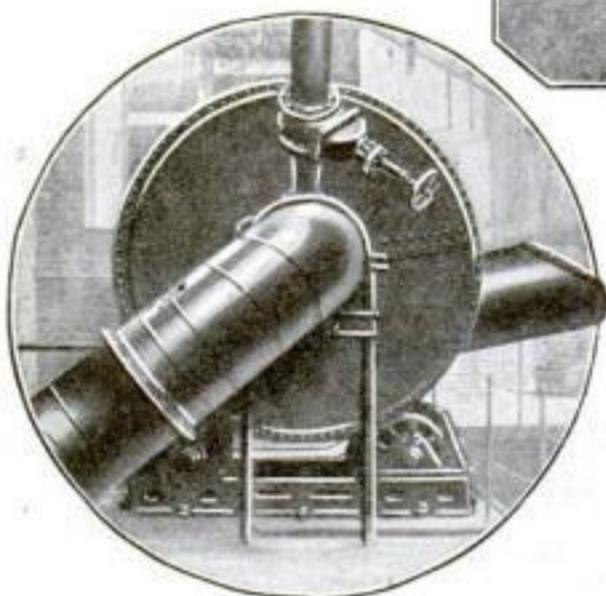
PRODUCTION of steel direct from the ore in five hours is the revolutionary accomplishment of the French scientist, M. Basset, whose process is now said to be developed on a commercial scale.

For years metallurgists have dreamed of a direct steel process, eliminating the spectacular Bessemer converter. Numerous methods have actually been tried out, but the Basset process is the first one for which really sweeping claims of success are made.

In the most efficient blast-



Brick retorts for superheating the air blast to 1800 degrees. They are fired by the carbon monoxide given off by the ore furnace



The hot blast is charged with a measured quantity of powdered coal dropped through the small pipe

furnaces far more coke is supplied to the charge than is theoretically needed to reduce the iron ore. The result is that the molten iron, which dissolves carbon almost as water will dissolve sugar, takes up an excessive amount of this element, which must be burned out of the pig iron by the open hearth or Bessemer process before steel can be made. In other words, the iron is first carefully supplied with too much carbon, and then the excess of carbon is laboriously burned out. This takes time and it costs money.

Basset has apparently solved the problem by mixing the iron ore with limestone in a rotary furnace. There is no coke in this charge, as is the case in the usual blast furnace. Instead, the carbon is supplied as finely pulverized coal, which is carried into the furnace by a blast of air heated to 1800° F. The quantities of air and coal blown through the ore are carefully regulated, so that the combustion in the furnace is incomplete. Even after all the oxygen is taken from the ore, the coal is only half burned. The gases given off from the ordinary blast furnace are largely carbon dioxide, CO₂. The Basset furnace produces only carbon monoxide, CO, which will not re-oxidize the metallic iron.

The high temperature of the Basset blast is obtained by passing the air through brick retorts that are heated by the gases given off by the furnace itself, which proves that the combustion is only half completed in the presence of the iron. Nevertheless, the heat produced in the furnace is amply sufficient to melt the iron, which is poured into molds in the usual way. When a pound of carbon is burned, about a thousand heat units are emitted in forming carbon monoxide, and nearly two thousand

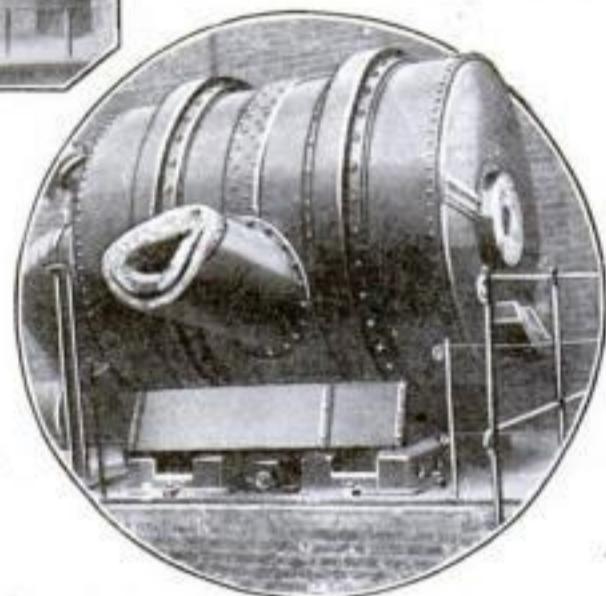
more when the monoxide burns to form the dioxide. By making these two steps take place in different furnaces, M. Basset reduces and melts the ore without danger of re-oxidizing it, and still gets enough heat energy from the pulverized coal to heat his air blast.

The new process will produce steel from ore in five hours. With the blast furnace it takes thirty hours.

Reports from Paris assert that in addition to the saving in time effected, iron can be produced 70 per cent cheaper than in a blast furnace, and 80 per cent is saved in the cost of installing the plant. The cost of subsequent operations in the manufacture of steel is also reduced, as the exact control of the amount of carbon supplied to the metal and the heat of the blast allow steel to be withdrawn directly from the furnace.

There are still many skeptics among metallurgists as to the commercial possibilities of the process, but M. Basset expects from it far-reaching benefits in France, since a poorer and cheaper grade of coal can be employed in smelting, and France will be enabled to make steel with the coal found within her borders, instead of importing coking coal from Germany and England.

Here in the United States, we have an abundance of good coking coal, and the steel operators are naturally loath to



Lined with refractory clay, the reduction furnace tilts to pour off the molten iron and slag

abandon their expensive blast furnaces until it becomes necessary or profitable for them to do so. In the West, however, where good coking coal is scarce, a successful process of this kind might help to build up a locally profitable steel industry.

Printing Our Own Postage Stamps

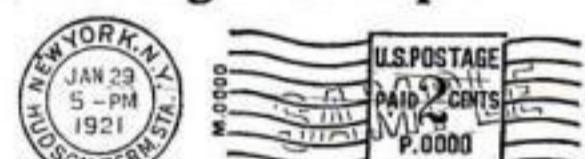
HAVE you received a piece of "metered mail" yet? You are certain to before long, for the newly invented postage meter is being adopted by many large concerns to speed up their outgoing mail. It will post-



The desk model postage printer takes up but little space and is hand-operated

mark, stamp, seal, count, and stack mail at one operation, and at the rate of forty pieces a second.

Instead of using postage stamps, the machine prints the date, the time, and "Postage Paid" on the envelope, using ink of the color of the stamp—green for one cent, red for two cent, and so on. Yes, but how is the Government sure it is being paid



This is the style of postmark printed by the postage meters

if no stamps are used on letters and parcels?

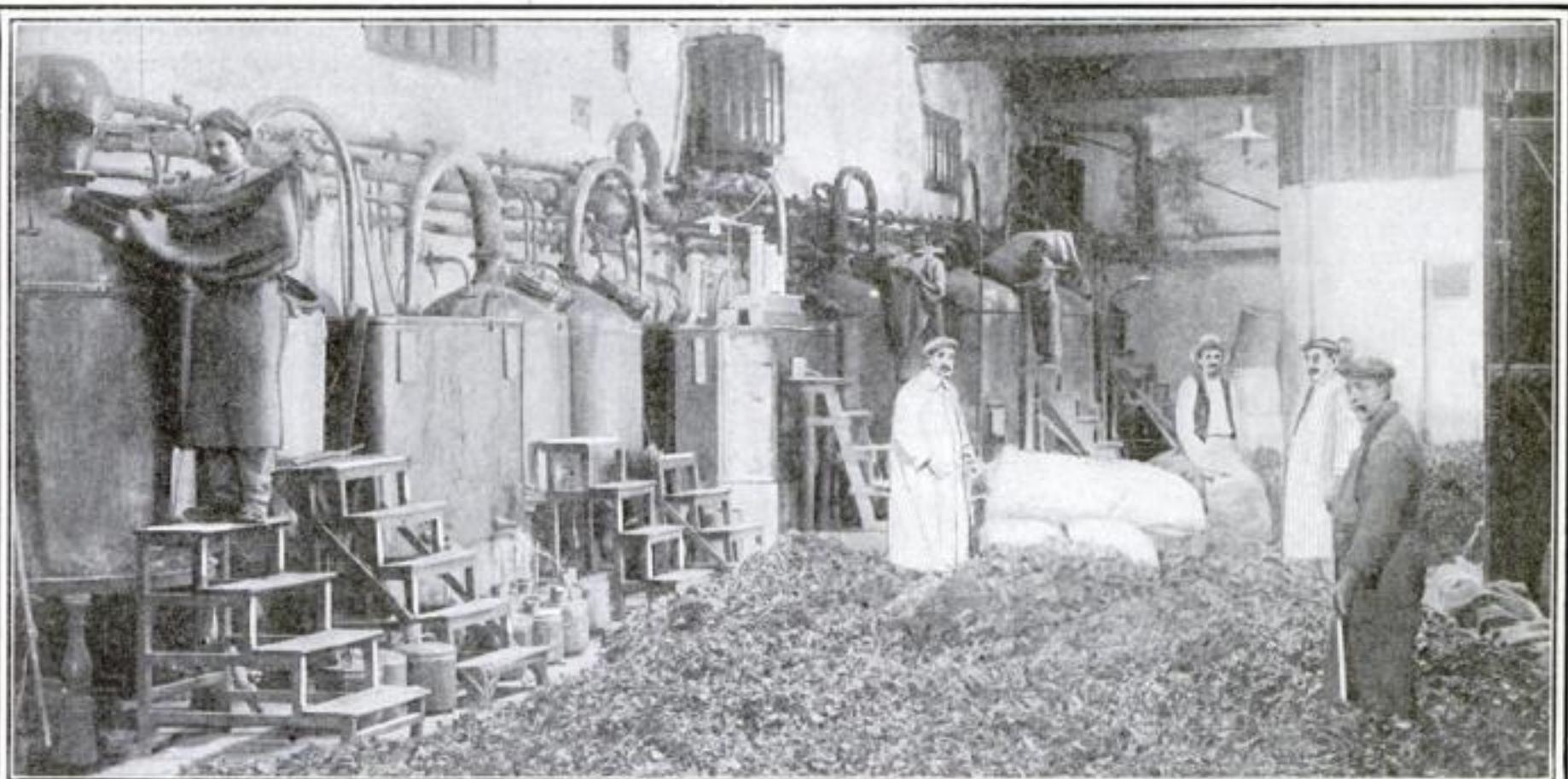
The meter attached to the machine is taken to the post-office, a payment is made, and the clerk unlocks the meter with a key in his possession. He sets it to print as many "Postage Paid" lines as you have purchased stamps and no more. After the last impression, the meter locks and must be taken to the post-office again.



For large business houses the motor-driven machine will postmark 250 letters a minute

The Perfume Industry of France

Where the rose, jasmine and cassia are robbed of their odors



Photographs © Ewing Galloway

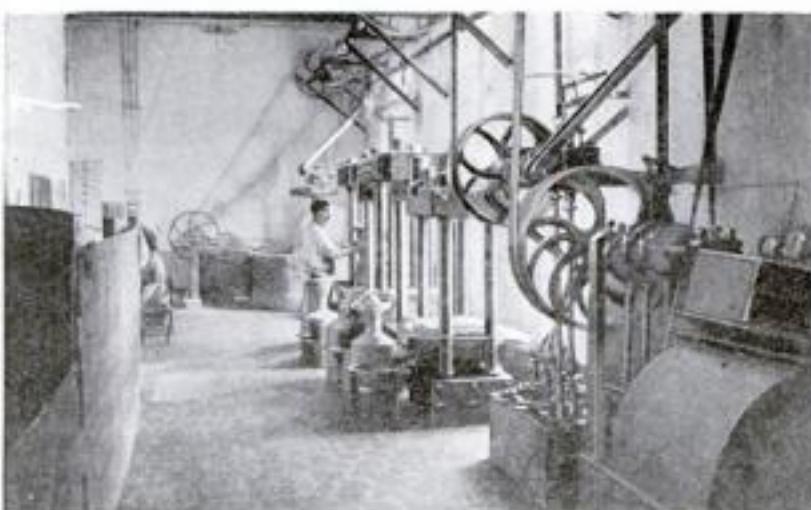
The receiving-room of a perfume factory, where the freshly picked leaves of the rose and other flowers are dumped before being thrown into the huge cookers shown at the left of the picture



A corner of the distillation room, where the flowers are distilled with water or superheated steam. The method of treatment varies with each flower or herb that is used



The mixing-room, where the attars are mixed in the proper proportion to obtain the exact scent. Most of the natural perfumes are mixed in solution with alcohol



Some perfumes cannot be obtained by distillation, but are gained by maceration or inflooding, both processes requiring a mixture with fat, and the perfume is then squeezed from the flower or fruit by these hydraulic presses



The essence secured from the flowers must be tested constantly in the laboratory to be certain that the final perfume does not vary, the most careful measuring of ingredients never producing the same strength twice

Music Now Comes on the Movie Film

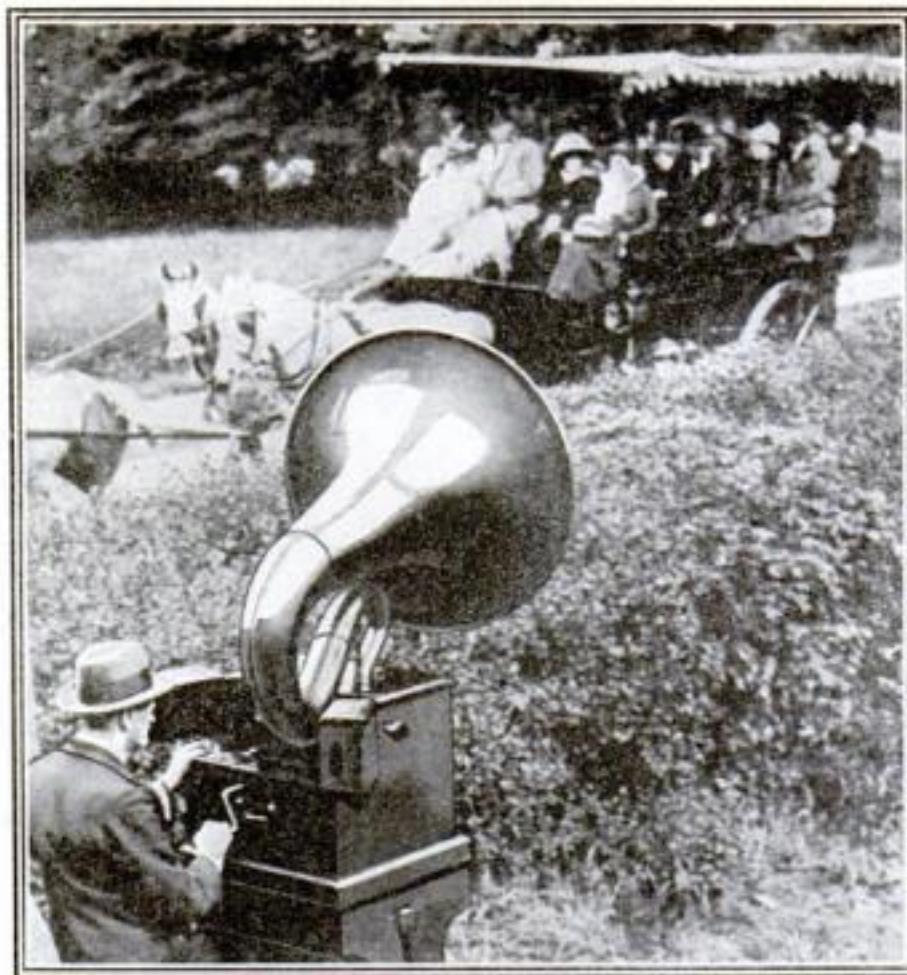
MUSIC is always served with moving-pictures, but if it isn't appropriate, it may easily spoil the effect of a picture.

We can now have music and pictures combined on a film in the manner shown below.

As the film is made up, music is selected and is reproduced along the lower edge of each section of film. Then, when the picture is projected on the screen, the music will appear at the bottom, where it is in full view of the man at the piano.



Suitable music for each picture is printed on the film



Enlarged Phonograph as a Vocal Sign-Post

IT is the custom in England to drive out to the Derby to see the races, and in the past, parties sometimes lost their way over unfamiliar roads. An English newspaper decided that the ordinary guide-posts were not enough, and installed a loud-speaking phonograph at every important corner.

The machine depicted shouted "To the Left! To the Left!" all day long. The loud-speaking attachment on the phonograph made it sound as loud as a man can shout.

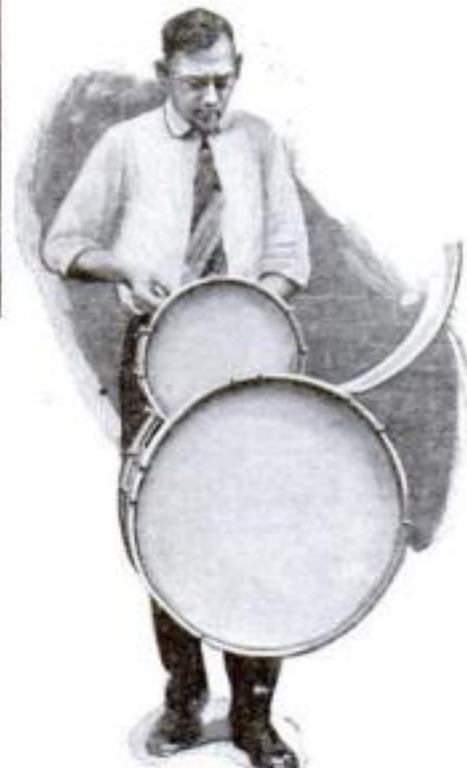
The invention was developed during the war to permit aviators to shout instructions to troops, even when flying a thousand feet above the earth. In the September issue, Popular Science Monthly printed an article on the invention of this amplifier.

Here Are Two Drums in One

FOR orchestra and band members this two-in-one drum will be found convenient. Not only may a smaller drum be placed into the larger one, but parts making up the drummer's trap supplies may also be placed inside.

The accompanying illustration depicts this novel instrument and the manner in which the small drum is inserted.

All that is necessary before placing the smaller drum and accessories into the large is to unlatch a hidden door that is built in the shell of the drum.

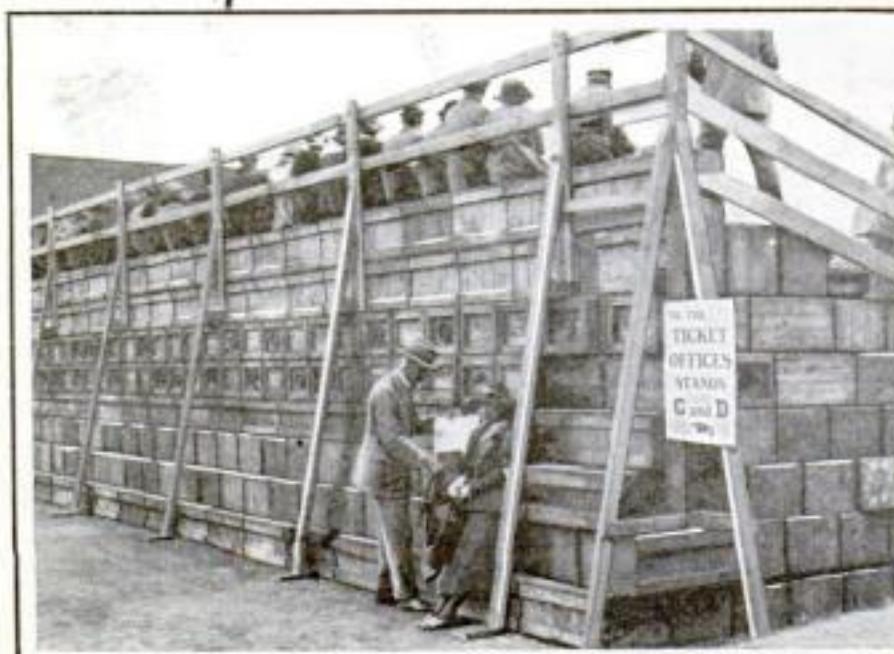


Showing how the small drum is placed inside the large one

Grandstand from Ammunition Boxes

SALVAGE of the war is now improving the standards of sport in England. This grandstand for the tennis matches at Wimbledon is constructed of ammunition boxes.

Unlimited amounts of these boxes can be had almost for the asking, and since they are about ten inches square and are exactly the right height for seats, no additional lumber is needed to make the stand. Virtually no carpenter work was needed for this job, as the boxes could be piled by common labor. They were received from the army with the covers already screwed on. As they were made of smooth planed boards and were already pointed, the stands were quickly built and gave perfect satisfaction.



Ammunition boxes brought back from France to England were used to build this grand stand

A Homemade Silencer for the Motorcycle

THE innocent little section of stovepipe that this man has attached to the muffler of his motorcycle is the terror of every dog in the surrounding countryside.

People complained that this man's motorcycle made too much noise. He is an enthusiast, and they declared he rode about so much they were unable to sleep. They became so bitter about the matter that he put on the pipe, which performs perfectly as a muffler. His machine is now absolutely noiseless. He travels down the road like a ghost. Except for the sound of the tires on the road and the clicking of the engine-valves, there is nothing to cause annoyance.



The piece of stovepipe on the motorcycle is a muffler and not a patent traveling stove



Scissors Create Scenery for Silhouette Movies

NOTHING less expensive for motion-picture production will be discovered than the new German silhouette film dramas. Double-exposure of the negative and the clipping out of small scenic frames of black cardboard is what produces the settings.

First, the negative is exposed to the motion of the silhouetted human figures, light being thrown on them through a screen, their camera side being wholly dark. The number of feet of each "shot" is carefully booked, and the negative next run through for a second exposure to take the setting, which need be no larger than a few inches.

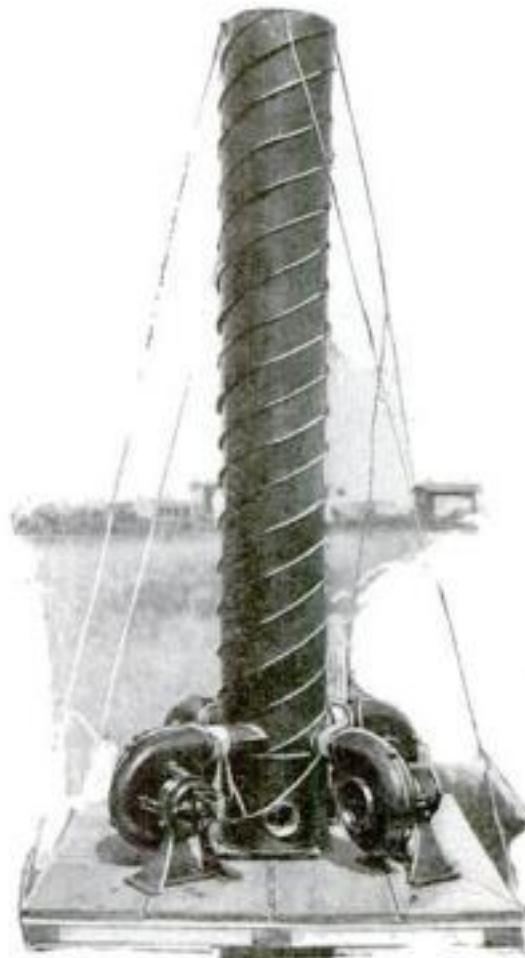
IT is tedious work to bore holes in hard soil by hand, yet this must be done before dynamite can be used to shake hard soils and form holes in which to plant trees and set poles.

A portable earth-boring machine, invented by an Illinois man, greatly simplifies the work. The device consists of a set of light tubular hinged trusses, the ends of which are fitted with gear-driven boring

gears to operate the augers. The machine will drive four drills more quickly than one drill can be operated by hand. Since the holes are spaced fifteen feet apart in the form of a square, hard-pan can be drilled rapidly for subsoil blasting.

The framework is designed to fold up and can be carried on the chassis of the automobile, the engine of which furnishes the power for the drilling.

Rain-Making Machine to Produce Natural Storm



The miniature tornado produced by these high-speed blowers is guaranteed to bring rain

FOUR blowers of one twentieth horsepower each, which force air through a spiral pipe at 1100 cubic feet a minute with a velocity of sixty miles an hour, are the features of a rain-making machine with which it is proposed to produce natural storms by artificial means.

After considerable research, it is the inventor's belief that by forcing warm air from the earth's surface up into high altitudes, an ascending chimney, or miniature tornado center will be created which will eventually produce an area of low barometric pressure with its accompanying fall of rain. By changing the position of

air gates in the base of the machine it is expected that a high-barometric storm may be produced whenever desired.

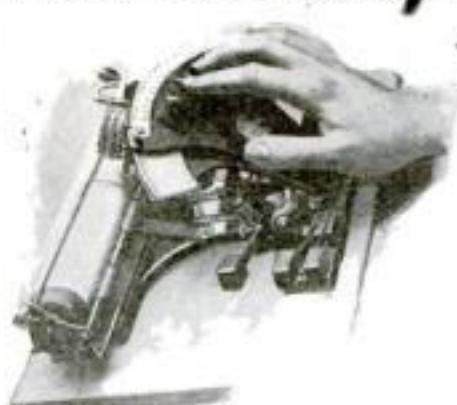
The illustration is a model. The full-sized machine will consist of high towers and motors of five hundred horsepower. While it is probably true that if an area of high or low pressure could be produced artificially, rain would follow, it is very doubtful if any human machine could move the hundreds of millions of tons of air involved in a space of time sufficiently short.

Portable Typewriter for the Blind

THE German government is marching abreast of the Allied governments, in teaching many of the men blinded in the war to earn their living as typists.

The illustration shows a special machine invented for use by the blind. The letters on the scale are in relief, so that the machine may be operated by feeling with the finger-tips.

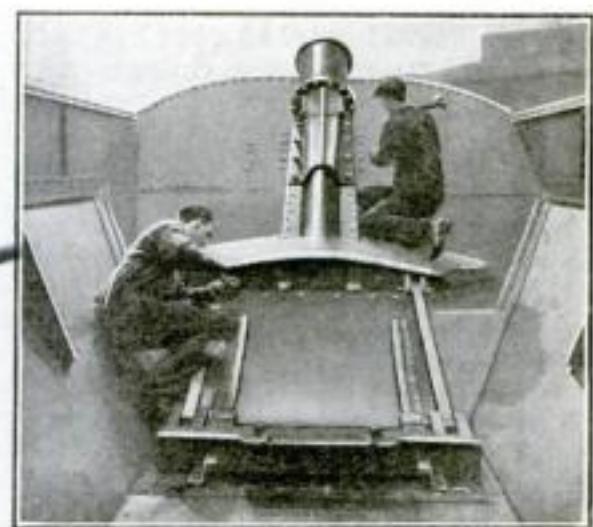
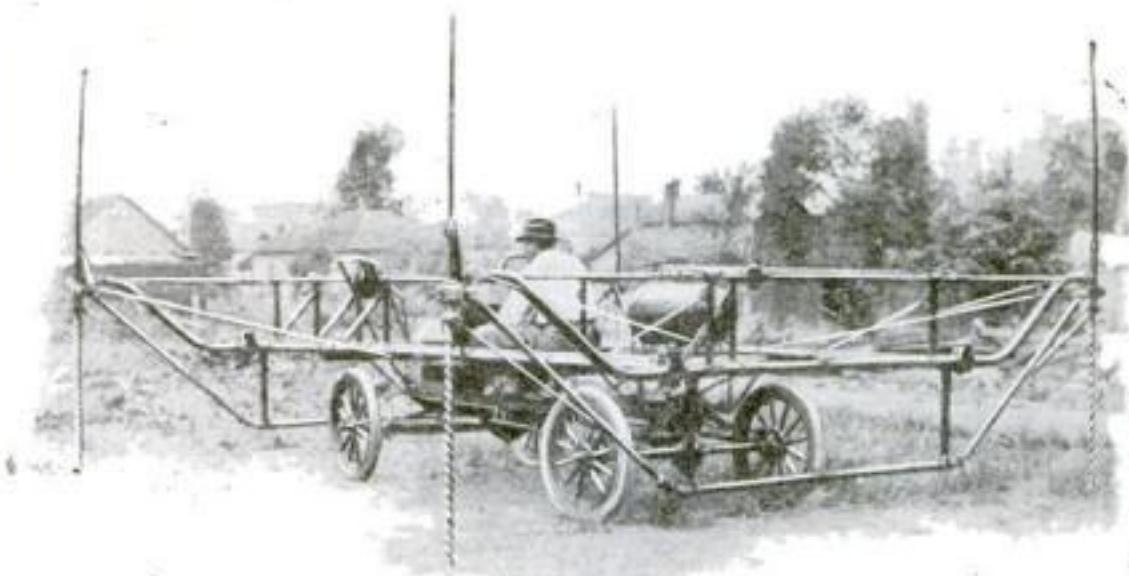
No typewriter ribbon is used. Thin printing ink from a reservoir on the right is distributed over the type by a roller.



Raised letters on keyboard allow the blind to operate this portable typewriter

Is your mind as keen as you think it is? Test it with the Sam Loyd Prize Brain-Twisters on page 74

Earth-Borer Plants Dynamite



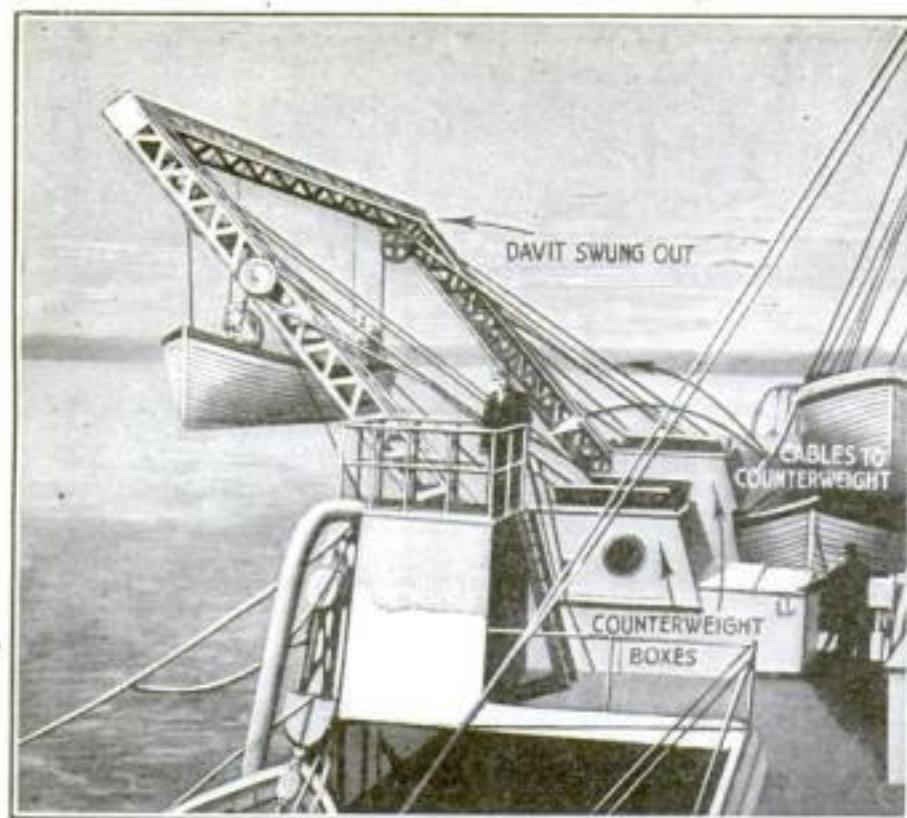
Coal-Pusher Saves Labor of Locomotive Firemen

FEW athletes have been known to train by taking a job as a fireman on a locomotive. Even if union rules did not forbid, they would probably find the work too hard and prefer some comparatively lighter toil like blacksmithing or lumbering. Indeed, the task of firing a modern freight locomotive is so arduous that the best "knights of the shovel" are being overworked, and the gigantic shovel shown in the sketch is being installed to lighten their labors. It is operated by compressed air, and pushes forward the coal in the locomotive tender on to the firing deck as it is needed.

New Process Extracts Oil from Apricot Kernels

APRICOT kernels, formerly considered as waste, are now being pressed to remove the oil, which has been found useful in making salad-dressing and for frying.

Hydraulic presses with a pressure of five tons to the square inch, extract the oil without the use of heat. Furthermore, it is not necessary to refine the oil before it reaches the customer. About twenty-five thousand kernels are needed to make one gallon of oil.



This electrically operated davit can lower twelve boats in nineteen minutes, and is not made inoperative by the listing of the ship

Davit Lowers Lifeboats Quickly

IN order to save the minutes which are so precious in time of disaster, lifeboat davits of a new type have been installed on the SS. *Arundel Castle*.

Davits have always had a bad habit of jamming or of lowering the lifeboat unevenly in an emergency. Another fault has been their inability to do the work when the roll of the ship was too great or the list too heavy. This new davit is said to overcome both of these handicaps.

As the illustration shows, it consists of two counterbalanced davit arms connected by a rigid crosspiece. When standing inactive, the davit is swung inboard out of the way; but when the electric motor is started, the davit swings out and so lifts the boat just enough to clear the ship's railing before it is finally lowered away.

As each of the lifeboats holds sixty persons and twelve boats can be lowered from each davit in nineteen minutes, it is easy to figure how quickly the passengers of the large ocean liner could be handled.

Odd Trolley-Car to Give Local Service from Express Trains

STEPPING off an express train going at sixty miles an hour sounds more like suicide than practical railroading, yet this apparently wild scheme has been proposed in order to shorten the time spent by the commuter in traveling between his office and home.

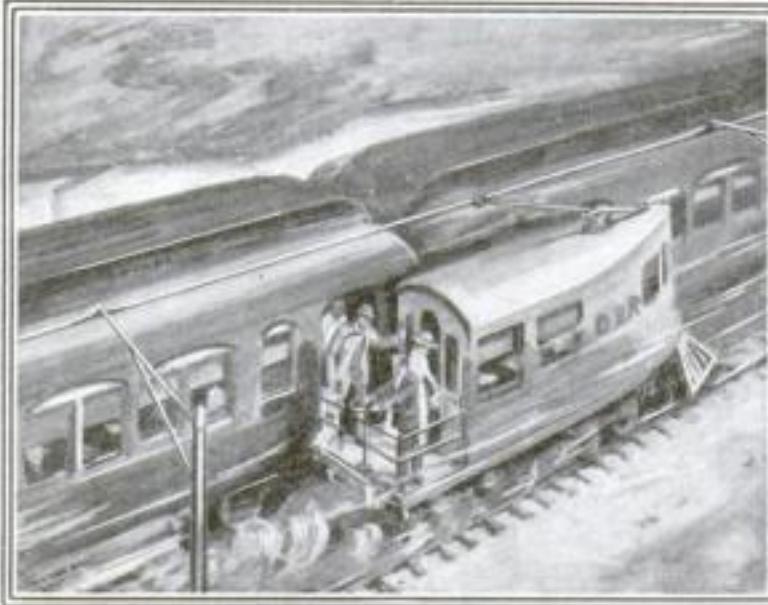
When the commuter steps off the train, he steps on to the platform of a trolley running on tracks parallel to those of the railroad at the same speed as the train. As soon as all the passengers are aboard, the trolley puts on the brakes and draws up at the local station, while the express train goes on without slackening speed.

The passengers would have to be standing in the aisles waiting for the trolley to pull up alongside, for a few moments lost in disembarking would require too long a stretch of trolley track. Even under the most favorable conditions, this track would have to be nearly three miles long—about a mile to get up speed, a mile and a half, or ninety seconds, to take

on passengers; and a half mile to slow down. Accelerating electric motors make the trolley able to get up headway sufficient to keep even with the train in a very few seconds. Although the train might be going a mile a minute, it would be no more difficult or dangerous to step on to the plat-

form of the trolley than it is to walk from one car of a train to another, since neither platform would have any motion relative to the passenger.

Not only would a scheme of this nature provide better service for the commuter, but because the stops made by the express would be reduced, the cost of operation would be lowered.



These illustrations show how the transfer between express trains and local stations would be effected

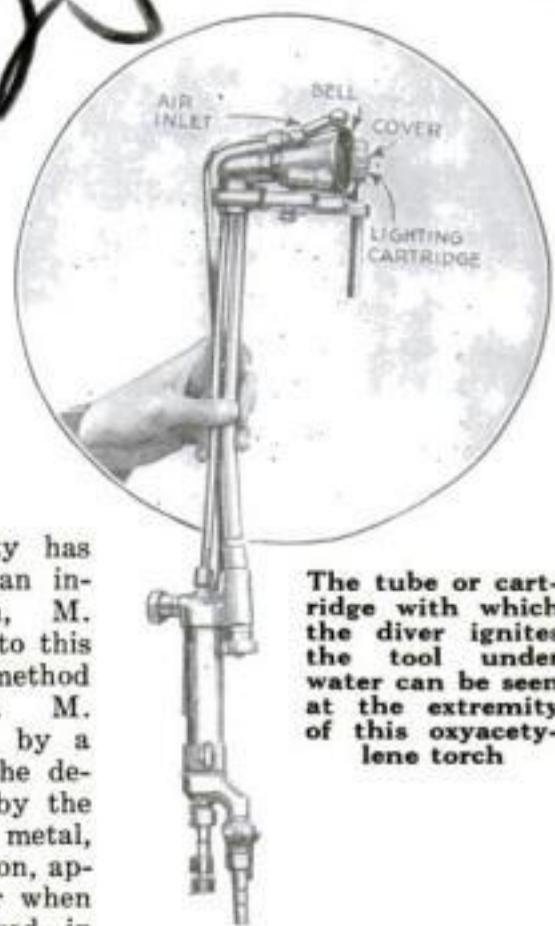
The Diver Can Now Light His Gas Torch under Water

THE method whereby an oxyacetylene cutting flame is made to burn under water, is simple. The tip of the torch is covered with a bell, to which compressed air is admitted at a pressure sufficient to keep out the water, this pressure being regulated according to the depth at which the work is being done.

The difficulty with this process is that the diver is forced to light the torch at the surface, and descend with it burning. If the flame is accidentally extinguished, which happens often, the diver is forced to the surface again to rekindle it. This entails a great waste of time and effort.

However, the difficulty has now been obviated by an invention of a Frenchman, M. Corne, who has applied to this peacetime problem a method developed for war use. M. Corne starts the torch by a flame generated from the decomposing water itself by the use of a secret alkaline metal, which, from the description, appears to be sodium, for when metallic sodium is placed in water, hydrogen is liberated and much heat produced; in fact, the reaction is so rapid that an explosion sometimes occurs. But as no free oxygen is produced, M. Corne, to get his reaction, adds an oxidizing compound. With the alkaline metal this oxidizing agent is enclosed in a brass tube pierced with vent-holes and provided with a hinged core to prevent accidental ignition of the materials.

The lighting device is placed near the tip of the torch on a jointed rod. When the diver has been lowered to the ship's side, to the lighter, he turns on the compressed air in the torch, admits the water, and in a second the oxyacetylene torch is lighted and he can begin to cut the steel plates.



The tube or cartridge with which the diver ignites the tool under water can be seen at the extremity of this oxyacetylene torch

Good Lumber Cut from Dead Trees

WHEN sound dead trees are sawn into lumber, there is no method known to the United States Forest Products Laboratory by which the wood can be distinguished from that obtained from live trees. If the tree stands on the stump too long after it is killed, the sapwood is liable to become badly damaged by wood-boring insects, and in time the heartwood will be similarly affected. The heartwood of all trees is entirely dead, and only a thin layer of cells just under the bark is actually living, so most of the lumber cut is sawn from dead wood, whether the tree itself is dead or not.



What Do You Want to Know?

Let Popular Science Monthly Answer Your Problems in General Science



Other Readers' Questions that Will Interest You Too

Is pure radium really used in making the luminous figures on watch-faces? If so, how is it that they can be sold so cheaply?—E. H.

No, the material on luminous dials consists of a minute quantity of a radium salt mixed with some phosphorescent substance as sulphide of zinc or barium. Such a combination will glow more in the dark than would radium, which, in its pure state, is not luminous. The reason that watches with luminous figures can still be sold cheaply is due to the fact that only an infinitesimal quantity of radium salts is needed to impart unusual luminosity to the inert salts of barium and zinc.

???????????

What is pongee? Does it come in any other color than tan?—J. K.

Pongee is a soft, unbleached, washable silk, made in China from the cocoons of wild silkworms. In its natural state pongee ranges from light pearl to tan in color, depending on the foods eaten by the worms, but it is frequently dyed for commercial purposes.

???????????

At what altitude would a human being die for want of oxygen?—A. L. O.

This depends on the individual. Some persons would faint at eighteen thousand feet, while others could achieve twenty-five thousand feet before feeling any ill effects. At something over twenty-five thousand feet, however, the average person would die for want of oxygen.

???????????

Can you tell me the area of the Pacific Ocean?—M. G. G.

It is impossible to define exactly the limits of the Pacific, but if all the seas bordering on it are included in the computations, the area would be approximately fifty-five million square miles.

???????????

What is ordinary gelatine made of? Where is it obtained?—F. K. I.

Gelatine is a substance made by dissolving in hot water certain parts of the bones and tissues of animals. Its exact chemical make-up is unknown.

???????????

Is there any difference between a hydroplane and a hydro-airplane?—S. A. M.

The term "hydroplane" is usually applied to motor-boats having the flat or V hull or a modification of either. A hydro-airplane is an airplane with a body

that allows it to rise from and alight on the water.

???????????

What are the advantages to a ship of having a gyroscopic compass?—P. S.

Once set to point north and south, the needle of a gyro-compass is not affected in any way by the motion of the boat nor by the near-by presence of metallic bodies.

???????????

What is the composition of brass; of bronze?—J. G.

Brass consists of about 30 per cent of zinc and the remainder of copper. Bronze consists of copper and tin in various proportions, according to the use to be made of it. For coins or tokens the proportions are 95 per cent copper and 5 per cent tin. A slight addition of other substances, such as phosphorus, zinc, or aluminum, produces other alloys known as phosphor-bronze, bearing metal and aluminum bronze.

???????????

In dyeing cloth at home it is necessary to buy and use one kind of dye for woolens and silks and another for cottons. Why cannot the same dye be used for both fabrics?—I. S. E.

Wool and silk are of animal origin. Cotton is from a plant and consists

Learn here the answers to many interesting questions asked by readers of Popular Science Monthly.

And ask questions of your own.

Every reasonable specific query in the field of general science addressed to this department will receive a prompt reply.

Readers who understand this service will appreciate, of course, that we cannot accept questions involving extensive research, answers too lengthy for the space of a letter, and sets of questions that can best be handled by individual study of available reference books. Legal and medical queries cannot be answered.

A stamped self-addressed envelope must accompany each question.

Address the Editor, Popular Science Monthly, 225 West 39th Street, New York.

principally of cellulose. Being of animal origin, woolens and silk are more active chemically than cellulose products, and will combine directly with many dyes. But cotton cloth demands a substance known as a mordant before dyes will affect it. Aluminum hydroxide is one of the mordants that make possible cotton dyeing with special basic dyestuffs.

???????????

What is the average velocity of a "shooting star?"—W. A. B.

Shooting stars have a speed estimated to vary from twenty to forty miles a second.

???????????

Some time ago I read of an Eastern professor who was making plans to send a rocket to Mars. What has become of the project?—C. I. P.

The moon, not Mars, was to be the rocket's objective. Professor Goddard, of Clark University, who was responsible for the original idea, is still carrying out preliminary experiments on smaller rockets. As soon as the most efficient type has been devised and tested, it is expected that a large rocket will be sent off on its long journey of 290,000 miles to the moon.

???????????

What is the commercial cost of liquid air? For what purpose is it mostly utilized?—E. S.

Liquid air costs about two dollars a gallon. It is used in the manufacture of nitrogenous fertilizer in experiments with low temperatures and in the separation of gases.

???????????

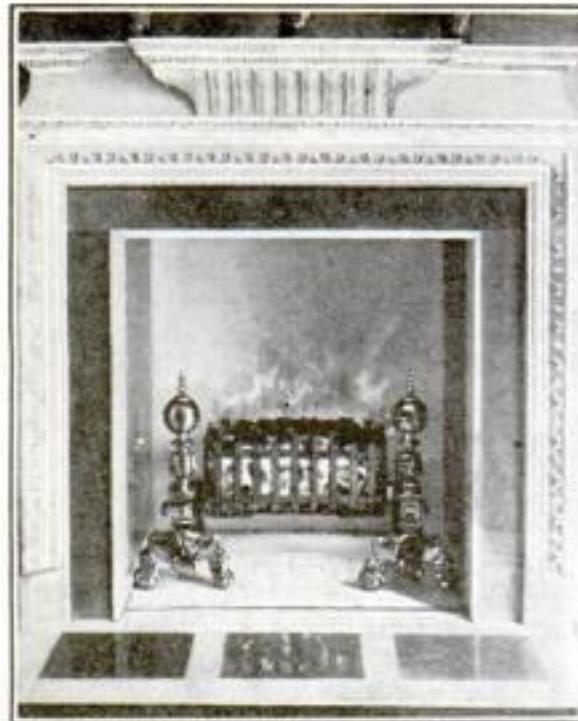
If a man held a light and a heavy article and let them fall from the same height at the same instant, would not the heavier article reach the floor first?—O. M. S.

Yes, unless the experiment were conducted in a vacuum, in which case they would reach the floor simultaneously. "The speed of a falling body is not inversely proportional to its mass" is a fact that was discovered by Galileo in 1590.

???????????

What voltage would be needed to run a 20 or 25 horsepower motor?—J. E. H.

The voltage required would depend upon the motor; it might be designed to run on 220, 550, 1200, or even higher voltages. The most desirable voltage would depend on the use to which the motor will be placed. Your question is vague.



An Open Fire without Smoke and Dirt

THIS looks like a coal-fire. The heat is the same; the same flickering light plays on the hearth and dances from the polished andirons—but there is no smoke and no dirt. A grate filled with colored chunks of Belgian glass, two electric lights, a pair of fans with aluminum blades, a switch, and an electric heater have solved the problem of how to combine the convenience and cleanliness of electric heat with the romance and beauty of the open hearth fire.

The lamps shining through the lumps of glass give them the appearance of blazing coals, and the heat arising from the electric heaters makes the two aluminum fans revolve just fast enough to cast the flickering light characteristic of the open fire over the room.

Wooden Tone-Arm for Use on Phonographs



RADICAL changes in design mark the wooden tone-arm for phonographs that has been invented by B. C. Repp, of Plainfield, New Jersey. The arm is made of solid wood and is attached by a linen thread to a sounding-box fixed immovably in the center of the instrument.

The ordinary metal needle is used, but the inventor claims the position of the tone-arm permits the needle to rest on the record at an unusually small angle. As a result, the needle slides more easily over the surface of the record, and scratching and harsh, metallic sounds in reproduction are reduced to a minimum.

The tone arm is built of wood similar to that used in the construction of violins, and the complete device is said to add to the beauty of tone of the music, and to prolong the life of the records considerably.

TRACING migratory birds by attaching metal bands to their legs has been practised since 1710. Hunters finding such birds should communicate with the Bureau of Biological Survey, Department of Agriculture, Washington, D. C.

Rapid Interest Indicator for Savings-Banks

A NEW system and device for quickly finding, displaying, and indicating interest on savings accounts of various amounts at various rates of interest, has been invented by Harry S. Moir.

The function of the invention is to locate quickly the amount of interest on an even sum of money for an even period of time without calculation or eye strain. This makes it possible to find the correct interest expeditiously, notwithstanding items of deposit and withdrawal. For example, if a savings account at the beginning of a year is \$10,000, the correct interest in anticipation of said amount being left in the bank at 4 per cent amounts to \$400. Suppose the next deposit is \$250. The interest is found by moving the gate-holder so that the pointer will point to 25, then sliding the gate so as to open the holder slot on the January columns, which shows the interest on that deposit to be \$4.90. Thus, in posting, it is necessary only to slide the gates from one of the columns to another, according to the date of deposits, and adjust the indicator according to the amount.



The complicated interest computations of banker and broker are handled easily by this attachment

The interest items are totaled on an adding-machine and the interest on withdrawals subtracted, giving the balance to be credited the depositor.

A Country Estate Built on a Factory Roof

1883

IN Cleveland, the manager of a manufacturing concern has arranged a country estate on the roof of his factory, a hundred feet above the street, which is unique in that it possesses an astronomical observ-



What appears like a back-yard garden is in reality a miniature estate on a factory roof

atory with a powerful telescope, and an extensive greenhouse used in raising vegetables for the firm's cafeteria and cut flowers for the offices and clubrooms.

Cypress and fir-trees planted on the roof give it the air of a genuine garden. All employees of the firm have free access to the garden. The beauty of the spot, with the view over Lake Erie, less than two hundred feet away, makes it a favorite gathering-place the year round. The garden has been laid out after a plan inspired by examples of the Spanish Renaissance.

Rotary Photo-Print Trimmer



1883

WET or dry photographic prints may be trimmed with this rotary cutter, which cuts more cleanly than the guillotine type, and which will handle a dozen prints at once. The tracks rods support a cutting

disk mounted on a wooden drum. The disk is rotated by a rawhide belt as the handle is pushed back and forth, and automatically sharpens itself by contact with the steel bed plate.

Contractor's Truck Carries Double Hoppers

1883

SO as to meet the demand for a truck that will handle building material expeditiously, and at the same time work in confined spaces and on soft ground, this new vehicle has been designed embodying the features that the experience of the building contractor has shown to be necessary.

The short wheelbase makes it easy to turn on an eighteen-foot subgrade. Pneumatic tires permit operation on soft ground and prevent the subgrades from being broken down. Smaller wheels on the front

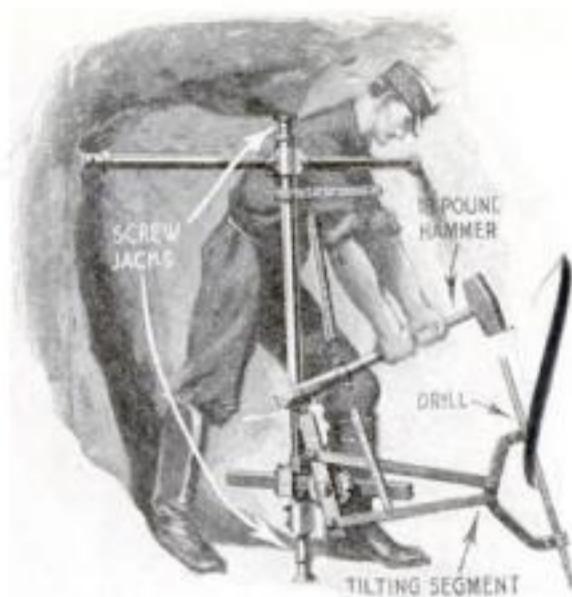


A divided truck body helps the contractor who handles several kinds of material

reduce the turning radius, and as all the load is carried on the rear wheels, the truck is just as safe as if larger and more expensive tires were used on all four wheels.

To unload, the driver raises a safety catch with a trip-bar and gravity does the rest. The shock is absorbed by the coil-springs in front of the hopper, and the tilt is controlled by a chain. These features allow merely a part of the load to be dumped. All working parts are protected from dirt. A three-point suspension motor prevents the transmission from being injured by road distortion.

A Hand-Power Drill for Prospectors



FOR over eight years John M. Calderwood sought to invent a mining-drill that would give the prospectors of the West the benefits of power drilling by a machine light enough to carry over desert country on the back of a burro and easier

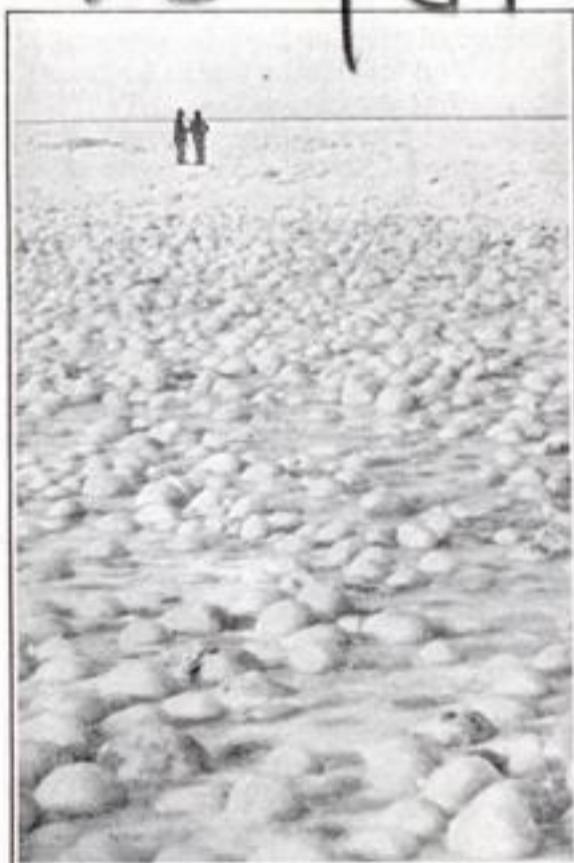
and more efficient in operation than the laborious hand-drilling incident to the use of single and double jack-hammers.

The illustration shows the successful outcome of his experiments. The Calderwood drill consists of an upright column with a standard screw-jack on the top and bottom for putting the machine in position in either tunnel or shaft. Sliding on the column is a collar holding a carrier mounted in a tilting segment, which can be fastened in any position by set-screws. It will be seen that this construction permits two complete circular movements of the drilling-tool, one vertically and one horizontally; adjustments can be made to the fraction of an inch in from one to three minutes.

A hole can be drilled by one man in about half the time required by two men with the old double jack-hammers. The mechanical sledge weighs eighteen pounds, and because of the attached springs is not harder to swing than the three and a half pound single jack.

Every Pebble a Hemisphere of Ice and Life

ON the beach in winter alternate thawing and freezing may create surprising sculptures in ice. The level snow-floor, perhaps several feet above the pebbles, begins to melt and the water collects between the pebbles. This makes the snow above melt faster, and where the beach is undis-

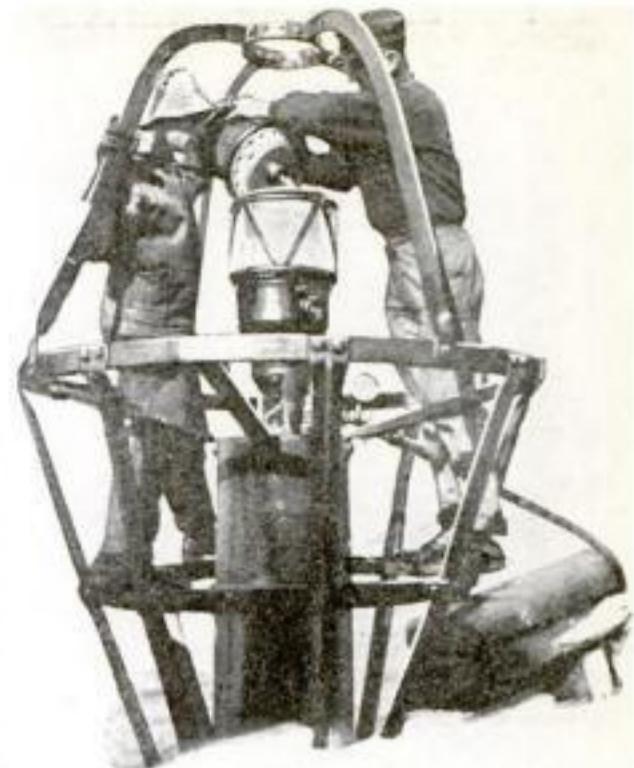


Frozen snow clinging to the pebbles gives a weird effect to this rock-strewn beach

turbed by waves, the water from the melting snow cuts away the depressions, leaving the packed snow on the pebbles in the form of hemispheres.

Curiously enough, these ice worlds are swarming with all kinds of germ life. Snow collects millions of germs in its folds, and these are present in the deposits on the pebbles.

After the snows of winter have each left their quota of bacteria in these shallow depressions along the shore, the spring sunshine brings the germs to life. Spores of plants as well as germs are deposited from the air by falling snow and rain, thus making of any beach a swarming hive of life.



A Million Dollars Lost if This Lamp Goes Out

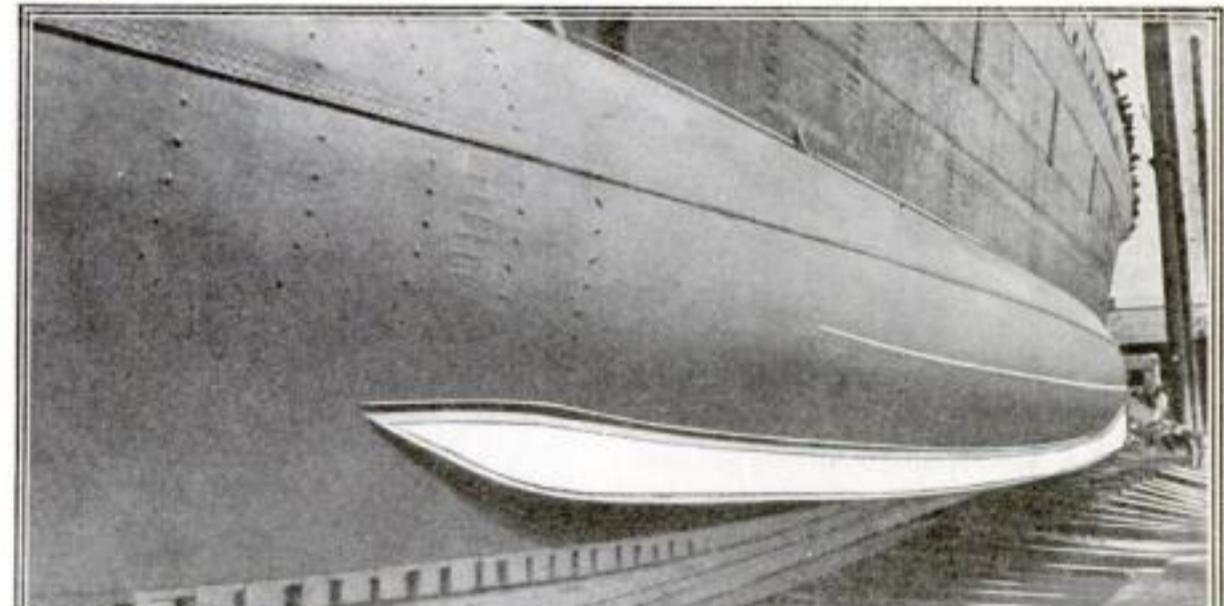
SAILORS rely absolutely on the fact that the ships and buoys tended by the U. S. lighthouse service will be in position with their lights burning under all conditions of weather and sea. It is rare indeed that their confidence is misplaced, and yet a buoy of the type illustrated is only supplied with fuel once a year. The crew is filling the tanks with compressed acetylene while they inspect the light mechanism which will give a ten-second flash every minute for the next twelve months, and if their work is not well done it may mean the wreck of a ship worth a million dollars.

Acetylene is but one of the many fuels used for illuminating the beacons along the coast of the United States. The principal source of light is the kerosene-oil-wick type of lamp. Then comes the oil vapor lamp using vaporized kerosene oil with a mantle, and in special instances even electric arc lamps and incandescent bulbs have been adapted for use in lighthouses and lightships.

Primitive Canoe Built of Inflated Skins

CRRAFT of this type are in general use on the rivers of Peru and the interior of South America. They are built of inflated skin, protected by a covering of reed mats lashed into mats like the new balsa rafts carried by our most modern liners.

Bulges on Cruiser's Sides Protect against Torpedoes



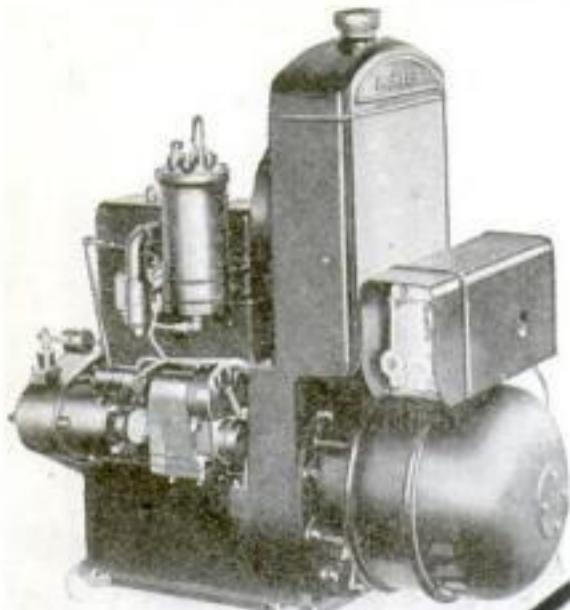
IN the British navy, where they were invented as a protection for cruisers against torpedo attacks, these bulges are known by the picturesque term of "blisters."

This particular illustration shows H.M.S. Epsom with one of the blister swellings under her waterline. The white fin along the side of the "blisters" reduces the skin resistance of the bulge and enables the ship to make better speed.

In construction these bulges are formed of a series of crosswise girders, which provide a cushioning effect in the event of a direct hit from a torpedo or the sudden shock of an aircraft bomb exploding alongside.

It is evident from published plans that the powerful Japanese battleships, Kaga and Tosa, described at length in the November Popular Science Monthly, are to be equipped with these unique protective blisters.

Power House Starts when Light Is Turned On



Above is shown a complete generating plant, which may be put in operation by turning on any light in the circuit it supplies. It is indeed difficult to see how a lighting coil, which is not burning will supply current for a light, but it is simple

Fast Grinding Compound now Used for Bearings

QUICK action in fitting bearings is secured with a new bearing-grinding compound in which a 90 per cent bearing surface can be attained in brass and anti-friction metal after from ten to twenty minutes of grinding. Cast-iron bearings averaging 15 per cent surface can be ground up to a 60 per cent bearing area in twenty-five minutes. After prolonged testing the shaft used throughout the trials showed no appreciable wear.

Although the compound is very fast-cutting, since the time saved runs from 75 to 100 per cent, it is not a grit or carborundum compound. The active principle seems to be a mixture of pulverized natural feldspar, sodium carbonate, cal-

enough to comprehend when it is learned that turning on the light causes the storage battery to discharge through the small motor, mounted on the side of the unit. This motor starts the gasoline engine, like any automobile self-starter. As soon as the gasoline motor has reached a certain speed, the small motor which served to start it is automatically cut out and the circuit to the light you turned on is also broken temporarily.

The generator, entirely enclosed by the drum, shown in the right of the picture, then begins functioning and delivers the power necessary for lighting your light up to the limit of the power of the unit, which is 1500 watts.

As soon as the current begins flowing into the line, it also flows into the starting battery, so that it will always have sufficient power to start the unit when you turn the switch.

Great changes in the load are followed so rapidly by the governor, that it is almost impossible to notice even a momentary flickering of the lights.



Ventilated Apartments Are the Style for Song-Birds

MANY songbirds of migratory habits will not go South in the winter if they are provided with a warm, comfortable nest and plenty of food. The Department of Agriculture has repeatedly demonstrated the advantage of using birds to protect the garden, but bird-houses suspended in the hot sun in summer and with no provision against the cold of winter are nothing more than slaughter-houses.

The construction of the bird-house built by Edwin H. Rieber, of Webster, New York, is almost ideal. It is a "ventilated apartment." An air space around the nest chamber and under the roof prevents the accumulation of heat in summer and retains enough animal warmth to keep the nest comfortable in winter. The inner chamber is formed of thin, spongy wood so that the moisture it absorbs will help keep the house cool in summer. Scientific calculation shows just how deep to make the nest cavity and how large to make the entrance to attract the species desired.



House-Moving in the Philippines

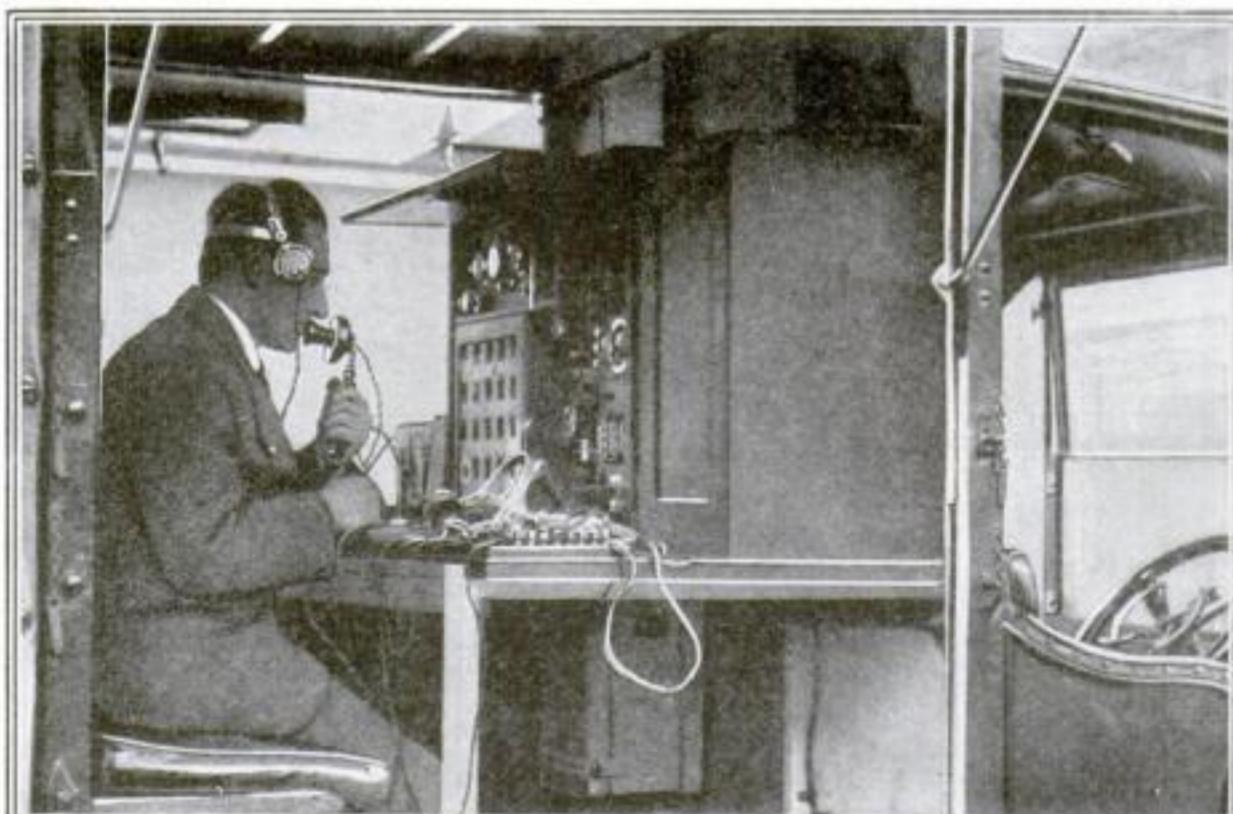
WHEN a Filipino moves to the next town he calls half dozen of his friends to help him. They pick up his house on their shoulders and carry it bodily to its new location.



A continuous bearing in twenty-five minutes of grinding is the accomplishment of this rapid acting abrasive

cium oxide, lampblack, and oil. Whatever the formula, it produces a better bearing than is possible by scraping methods, for these leave numerous high spots which make it necessary to take up the bearing as they wear down, whereas a ground bearing has a continuous surface to start with.

ONE of the very simplest and safest methods of fireproofing dress materials of linen or cotton consists in sizing them with a starch compound composed of 30 parts of sodium tungstate and 20 parts of borax dissolved in water and mixed with 50 or 60 parts of starch. The compound will not injure the fabric.



SUCH a multitude of motor-cars thronged the roads to Croydon, England, on the occasion of the aerial Derby that traffic was directed from a dirigible 2000 feet in the air. The traffic officers far

above the road were able to see the problem as a whole, and by relaying their orders via wireless telephone to the truck station on the ground, here illustrated, everything was kept running smoothly.



Baby's Bath with All the Latest Improvements

A COMBINED bath and dressing-table for the baby, which gives mother the opportunity to bathe him in the bathroom without carrying water or stooping, is recommended by physicians and nurses expert in the care of babies. It is made to fit over the regular tub, and when not in use folds out of the way against the wall.

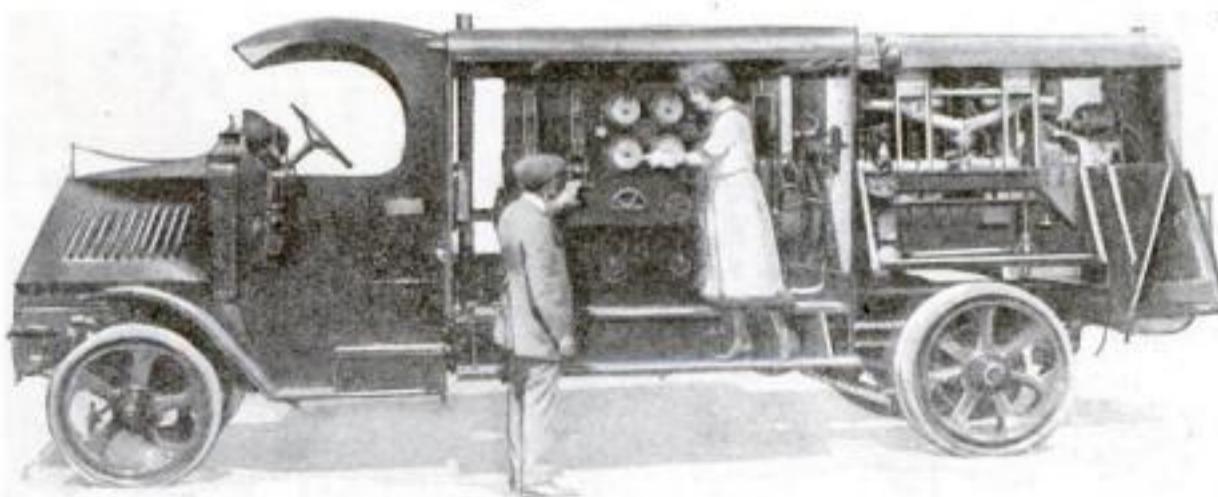
This improvement is one of many inventions that are beginning to take the back-ache out of women's work. The bath and the table are waist high so that there is no need to bend over while washing or dressing the child. The bath itself can be filled by a hose from the usual faucet. The apparatus takes the drudgery out of baby's daily bath and makes cleanliness a happy achievement.

Animal Life in the Sky

EXAMINATION of many specimens of meteorites has revealed the presence in them of living organisms. On being placed in the laboratory under suitable breeding conditions, the samples came to life and multiplied.

Further study of these micro-organisms will go a long way in verifying the claims of certain scientists as to the animal life existing in other worlds.

Movies Now Carry Their Own Power Plant



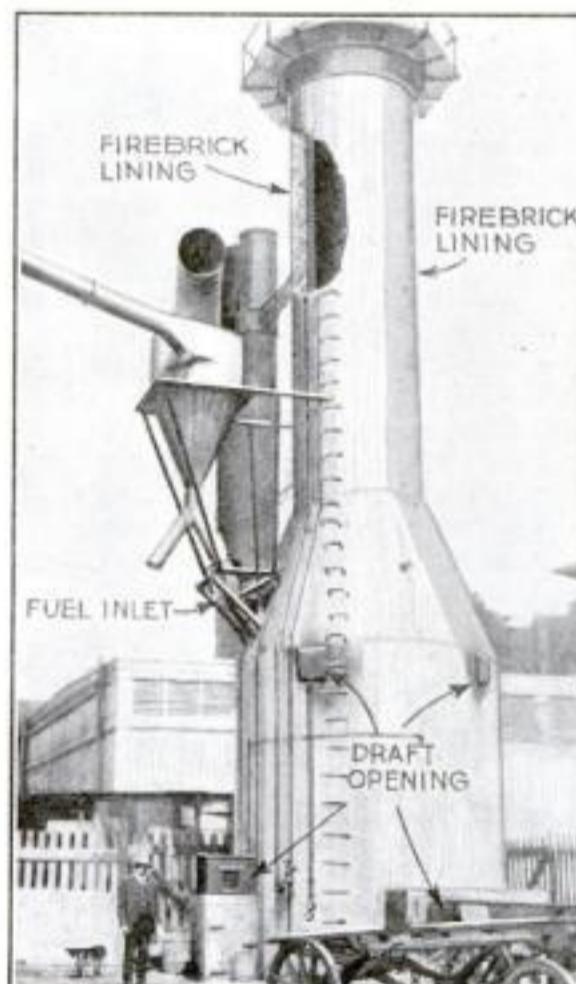
A powerful water-cooled gas-engine on this truck drives a generator that produces power for the searchlights used in making motion-pictures

THE majority of motion-picture films are produced "on location." This may mean a beautiful spot just outside the studio door or it may signify a thousand-mile trip to a mountain top or a desert waste. Some of the location views must be taken at night, necessitating some source of current for the numerous flood- and spot-lamps used. Self-contained power plants on trucks are used for this purpose.

Wind Creates Natural Draft for Sawdust Incinerator

1877
IN this improved sawdust incinerator, wind blowing from any direction is used to create a forced draft by its passage between the baffled openings and outlet holes in the conical section of the stack. The air also cools the exterior shell so that hardly any warmth can be felt on the outside, even when the sawdust is burning full blast.

There is an inner stack of firebrick, with upper and lower inlets on four sides that register with those in the outer concrete



Openings pointing every way insure sufficient draft whatever the direction of wind

1878
shell. All these inlets have baffled openings so that the air admitted to the stack is under control by the fireman. Sawdust is supplied to the incinerator automatically through the blower shown at the left.



Street Stations for First Aid

1879
SMALL first-aid stations completely equipped with medicines and materials likely to be needed after a street accident, have made their appearance in some of the cities of Europe.

The cabinet is operated like an American fire alarm. When an accident occurs, the policeman breaks the glass over the little door in the center of the panel and the cabinet opens automatically. Inside are a stretcher for serious cases, drinking water, tourniquets, antiseptics, and bandages needed for taking care of an injured person while awaiting the arrival of the ambulance.

Separates Liquids from Soil

1880
BY the use of a centrifugal separator of unusual power, M. S. Anderson, of the Bureau of Soils, has already demonstrated that the salts appearing in soils are more complex than has been hitherto believed.

The separator was designed to expedite the analysis of the soil of farms and the



The Bureau of Soils is using a cream-separator to separate liquids from soil during tests

1881
earth that is to be used for building roads. With a maximum speed of 17,500 revolutions a minute, the machine separates the liquids from the solid particles of the soil with unprecedented rapidity, permitting analysis in wholesale quantities.

Centrifugal Force—the Energy that Snaps the Whip and Dries the Clothes

How terrific destructive power is usefully applied in industry

"GO Slow—Dangerous Curve Ahead" warns the sign by the roadside, but if it were made to say what it really means, it would read, "Look out for centrifugal force," for that is the mechanical principle which causes most of the accidents along the highways.

Centrifugal means "the tendency to fly away from the center." You will remember that Newton's second law of motion is to the effect that matter always seeks to move in straight lines. When anything moves in a curved or a circular path, it does so under protest. It is always trying to break away and follow its inclination to travel in a straight line. The simplest illustration of this is the boy's toy sling.

You remember how you used to whirl a stone around your head on the end of a string and how far it would travel when the string was released. The cord compelled the stone to move in a circle, but it was always trying to fly at a tangent to the circumference and did so when released.

But centrifugal force, like fire, is as helpful as it is dangerous. Once it is allowed to become unmanageable, it will wreak disaster, but if properly applied, it is found to be one of the most useful forces in nature. With the aid of friction it moves the automobile along the road. As used in the steam-engine, it even keeps a check on itself, for the engine governor operated by centrifugal force is the only thing that keeps the engine flywheel from speeding up and whirling itself to pieces by centrifugal force.

It Made White Sugar Possible

Before the application of centrifugal force pure white sugar was unknown. Batteries of centrifugal separators now form a vitally important part of the mechanical equipment of every dairy and chemical plant. Without its use it would take days instead of hours to finish our laundry. The phonograph and the passenger elevator would be impossible, and it would be as dangerous to run a steam-engine as to manufacture dynamite.

By recalling again the toy sling, it is easy to see that the amount of centrifugal force will vary directly with the weight of the wheel or other body being revolved and with the speed at which the body is being rotated. These unchanging properties of centrifugal force are what makes it so valuable. Suppose, for instance, you want an engine to turn over at a constant rate of speed, not necessarily a huge engine, but a small one like the spring engine that drives your phonograph. Or suppose you merely want to make sure that the engine will not speed up above a certain point, such as the motors operating elevator hoists. How can a governor be designed to do this? A governor that will be simple and absolutely positive in its action? Only by taking advantage of centrifugal force.

In an engine governor, two hinged arms

attached to a revolving spindle are directly geared to the flywheel. When the engine is at rest, the force of gravity makes the arms hang down, but as soon as it begins to turn, centrifugal force impels the arms to fly away from the axis of the spindle. They rise up against the force of gravity, and the faster the spindle turns the nearer the arms will approach the horizontal. The arms are connected with a lever controlling the throttle-valve, which is slowly shut as the flying arms of the governor lift. The faster the engine turns, the less steam is admitted to the cylinders, and if the speed approaches the danger point, the governor will shut the steam off altogether. When the engine slows down, the arms fall, and more steam is admitted. In this way the speed can be kept constant.

Governors are so designed that the steam will be shut off if they break, since without some device to prevent the speed from increasing, a steam-engine would revolve

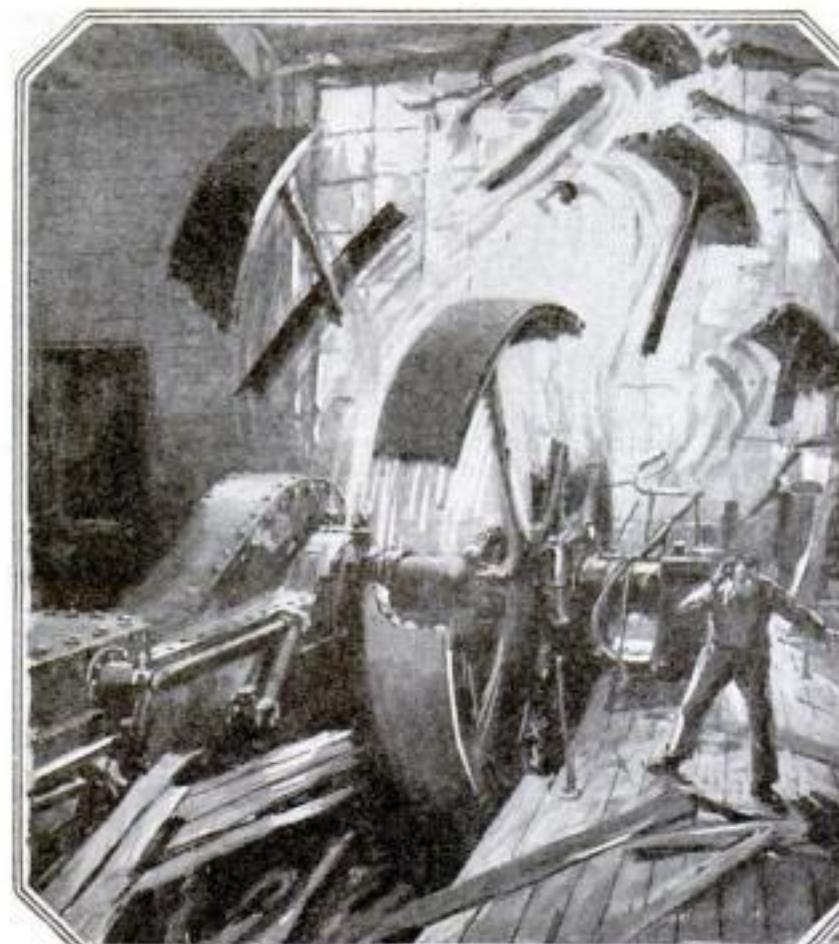
so rapidly that the centrifugal force developed by the flywheel would break the engine to pieces. In this way the engineer prevents such an accident by a clever use of the very force that causes the possibility.

Another general type of centrifugal machine takes advantage of the fact that at constant speeds the amount of centrifugal force depends on the weight of the substances revolving. You remember that you can swing a pail of milk round and round over your head without spilling a drop, because centrifugal force holds the milk against the bottom of the pail. Now, if you could swing that pail fast enough, the

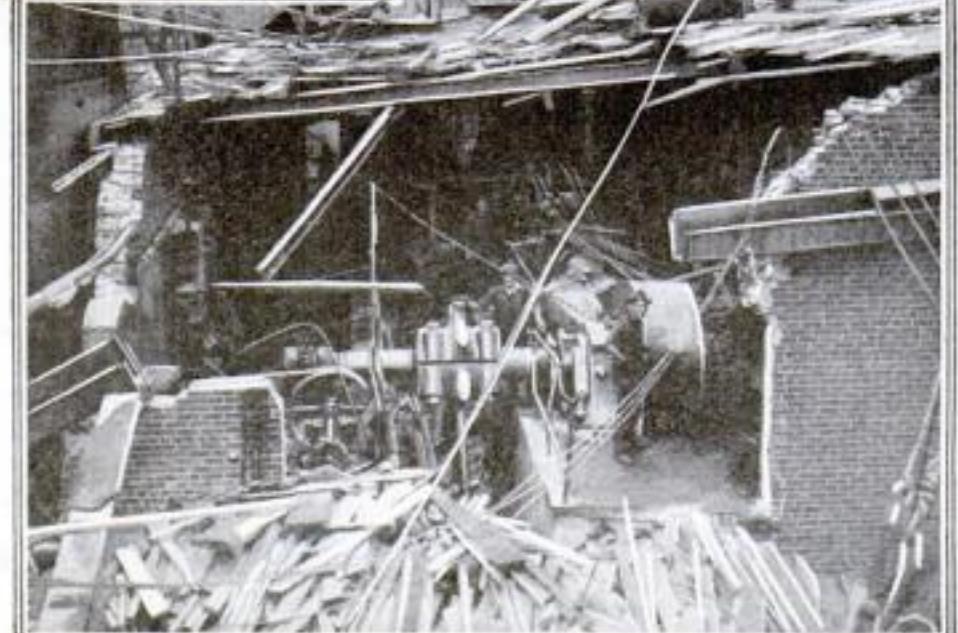
skim milk would collect in the bottom because it is heavier than the cream. Hundreds of machines employ this principle of centrifugal separation.

For Separating Liquids

Milk, or oil, or paint, it makes no difference what the substances may be; whenever two liquids differ slightly in weight we can separate them by revolving the mixture rapidly in a bowl and drawing off the heavier mixture from a spout near the circumference and the lighter one from an opening closer to the center. By changing the position of the spouts, we can get just the percentage of mixture we please. By slight variations in speed and adjustment, for example, a cream-



There is an interesting paradox in steam-engine design. Centrifugal force is used in the governor to prevent the engine from running away and destroying itself through centrifugal force exerted on the revolving flywheel. The illustration above pictures the chaos in an engine-room when the governor fails to act and allows the engine to tear itself apart.



Illustrated above is an actual scene of what happened to a plant when an engine got out of control.



Centrifugal force really killed Goliath. When David swung the primitive sling around his head, it was centrifugal force that gave momentum to the stone



In every modern laundry/centrifugal force dries the clothes. This metal basket is whirled at a high velocity, throwing the globules of water to the outside through perforated holes.

separator will turn out a cream so thick that it can scarcely be poured, or the thinness of skim milk. In the same way water and dirt can be cleaned from oil more efficiently than it can be removed by the most elaborate straining.

Many modern dryers are also centrifugal machines. In sugar-drying machines the bowl has an inner lining perforated like a sieve. The moisture is forced through the material and driven out through the holes, while the solid substances are held against the side of the walls. As the machine starts to slow down, the moisture trickles off, and a few moments later the dry sugar is allowed to fall through the bottom of the bowl into a conveyor waiting to receive it.

Before the introduction of centrifugal machines, in 1850, sugar was light brown instead of white in color, as it was impos-

sible to strain off all the molasses. The separation is essentially an accelerated screening process, which is the same in principle as filtering by gravity, but centrifugal force in the usual machine is from four hundred to six hundred times as powerful and the drying process is almost unbelievably thorough and rapid. In one sugar refinery four centrifugals operated by two men purged, washed, and dried thirty-five thousand pounds of sugar in one hour and three quarters. One dryer will handle three hundred pounds at a load and since it requires only thirty-five seconds to stop or start the best machines, from twelve to fifteen charges can be treated in an hour.

Virtually all drying of chemicals is done by centrifugals, since the machines can handle any granular and fibrous matter that will permit the liquid to seep through.

For this reason city laundries use centrifugals for drying clothes. It is a scientific application of the method used by a dog when he shakes the water out of his coat, and you can imagine that after being "shaken" at over three hundred revolutions a minute the clothes are as dry as if they had been hanging in the sun for hours. The clothes are held firmly against the sides of the basket, and there is no tendency to break or weaken the fabric.

Freeing Compressed Air from Moisture

In some industries centrifugal separation is accomplished without the use of whirling machinery. In freeing compressed air from moisture, for example, it has been found that sending the air through a specially designed pipe elbow, which forces it to whirl in a helical path around a central core, will strain out the water perfectly. The moisture is so much heavier than the air that it will not take the turn as readily. Centrifugal force throws it out of the path of the air against the wall of the pipe, from



Cream-separators would be impossible without centrifugal force. It is this force that draws the cream from the milk and carries it to the top of the bowl, where it drops by gravity into the cream-can.

which it trickles down slowly into a receiver.

An elaboration of this principle is used in Norway to separate the nitrogen and oxygen of the air. These gases are almost the same weight, but although the relation between their densities is as 14 : 16, when they are forced to turn an elbow at high speed, the heavier oxygen will be thrown against the outer wall. This demonstrates the great delicacy of centrifugal methods of separation.

There is again the danger from centrifugal force that lies in wait at the curves along the highways, for a speeding automobile tends to keep moving in a straight line, and if it be turned too sharply, centrifugal force will lift the inner wheels from the road, or even turn the car into the ditch. The "Go Slow" sign at the turn is really a warning against centrifugal force.

How To Be Measured for a Set of False Teeth



A GAGE for measuring artificial teeth has been devised by Dr. William C. Darbey, of Shanghai, China. It consists of a horizontal bar that is rested on the

head of the patient, and two depending bars, each of which carry measurement markings on their lower portions.

These bars are pivoted to the horizontal bar, and one of them may be slipped along this member to adapt the instrument to persons having faces of different degrees of fullness. When these bars are brought into alignment with the jawbones of the person desiring artificial teeth, a pointer indicates the proper size on a scale. The scale is marked with the proper size and form of teeth required for every conformation of skull and jaw, so the dentist is relieved from all uncertainties in the prescription.

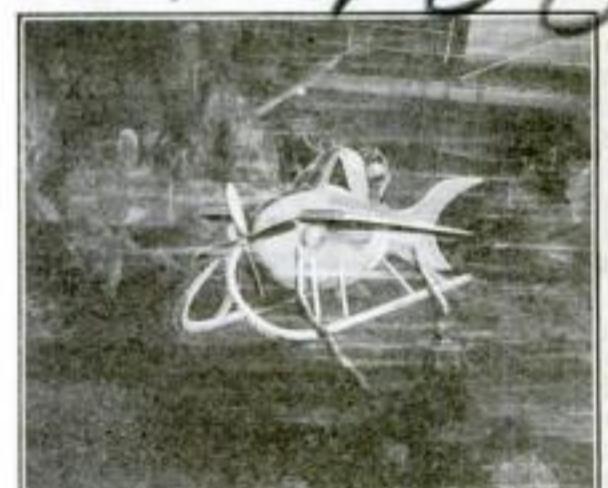
Tropical Lineman Has Hard Job

CERTAIN parts of South America are the habitat of a large spider that weaves its web around the telephone wires strung on the cross arms of poles. The spider is enormous and its web is heavy and of a thick texture.

The telephone companies were much perplexed when in the late evenings and nights frequent short circuits tied up their lines. After a time they discovered that the trouble arose from the heavy spider webs. When the sun was out, the webs were dry and there was no trouble; but at night, when the webs were covered with dew, short circuits occurred. The only remedy is constant brushing away of the webs from the telephone wires.

Submarine Mine-Sweeper Enters the Movies

BUILT to cut wire entanglements and sweep mines during the war which is the explanation of the saw-teeth on the



Used by the Germans during the war, this mine-sweeper has become the property of a film company.

runners, this German submarine sled is now the property of a moving-picture concern. It is as large as an airplane, and moves along the bottom of the sea under its own power.

The driver is encased in a diver's suit, and the invention affords an unequalled opportunity for taking pictures of the aquatic life beneath the surface of the sea.

Identifying Criminals by Their Pores

A pore-print taken at the scene of crime



A pore-print taken from the suspect



Pore-prints are as infallible as finger-prints. The arrows point to a characteristic in each print that positively identifies the suspect. The ridges at the arrow-heads are similar in alignment and each contains the same number of pores

NOWADAYS, the ease with which criminals may be identified by finger-prints is well known. But sometimes the finger-prints are blurred, half wiped out by the thief, or only a very small part of the finger-tip is shown. In these cases, which are becoming more frequent as the underworld recognizes the danger of leaving finger-prints on the scene of crime, this method of identification is impractical. In order to identify the criminal from the smallest and most fragmentary imprint, a French scientist has perfected a positive method of identification through the individuality of the innumerable sweat-glands on the fingers.

In an enlarged photograph of a finger-print the orifices of the sweat-glands appear as small black dots upon the convoluted ridges that make up the imprint. Scientists have discovered that the number of these glands, their arrangement, and position, is different for every individual, and like the pattern of the finger-print itself, never changes during life. It is clear then, that here is a scheme of identification that may be employed when the usual finger-printing methods fail.

Even the shape of the mouths of these glands varies. Usually it is a perfect circle, but often the prints will show an oval, a triangle, or an ellipse.

The usual method of taking finger-prints, which employs printer's ink, is not suitable for showing these pores, as the ink is somewhat greasy and fills them completely. Graphite and lampblack have the same effect. Pore-prints should be taken with a light powder such as copper oxide or white lead.

A little of this powder is blown on the finger-prints discovered at the scene of the crime, and then they are photographed by a camera, which enlarges the print several hundred diameters, so that the sweat-pores appear from six to eight millimeters in diameter in the print. The same method is taken to get a finger-print from the man suspected of the crime, and from this point on the identification is simple. It is only necessary to compare the number, the position, and the form of the visible pores. If

these correspond exactly, the man is guilty, without a doubt.

The method is not confined to the pores of the fingers, since the arrangement of the glands on any other portion of the body is equally characteristic. In a recent police case in Lyons, a thief took the precaution of wearing gloves, and left no finger-prints at all. The police discovered, however, that he had rested his forearm on the marble top of a table. A print was taken, and a positive identification effected by an examination of the pores.

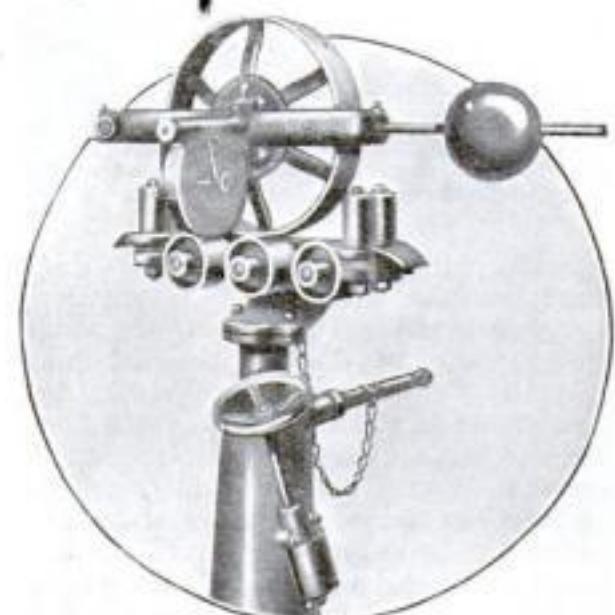
The criminal of today has indeed to "watch his step" to elude the fast-closing circle of identification tests that the modern criminologist has at his command.

This Machine Measures Wire of Any Size

IN measuring wires and cables correctly it is essential that they pass through the machine in a straight line, and that the measuring wheel be of ample size and offer no resistance when it is set in motion. These features have been embodied in the invention depicted, which will measure any wire up to cables two inches in diameter.

Glide rollers front and rear of the press wheel keep the wire from sagging, and the measuring wheel is four feet in circumference.

Both the wheels run on roller bearings, and may be spun with one finger while a



Cables up to two inches in diameter can be measured with this machine. A dial automatically indicates the cable's length

pressure of one hundred and ten pounds is exerted on the wire.

The pressure is adjusted by means of a sliding weight and rod placed on either side of the swinging cradle. The resetting of the dial is accomplished by means of a disengaging mechanism, and the height of the wire from the floor may be varied from thirty-four inches to four feet.

Fossil Shark Could Swallow Small Whale

Courtesy American Museum of Natural History



The jawbones and teeth of an extinct shark which swam along the coast of Florida several million years ago. Below, at the right, a specimen of the small sharks that now frequent our coasts

THIS jawbone of a fossil shark set up at the Museum of Natural History in New York City, gives an idea of the monstrous size of some of the fish that inhabited the seas in past ages. From the size of the bones that have been dredged from the ocean bottom it is believed that sharks ninety feet or more in length have existed. The most formidable of all present-day sharks, those found in the tropical seas, seldom attain a length of more than forty feet.

Science has found a way to use the skin of the shark for making durable leather and the bones and flesh are good for fertilizer, also the fins of some species of shark make a very tough gelatine. Shark-fishing, like whaling and sealing, has now become an industry in itself.

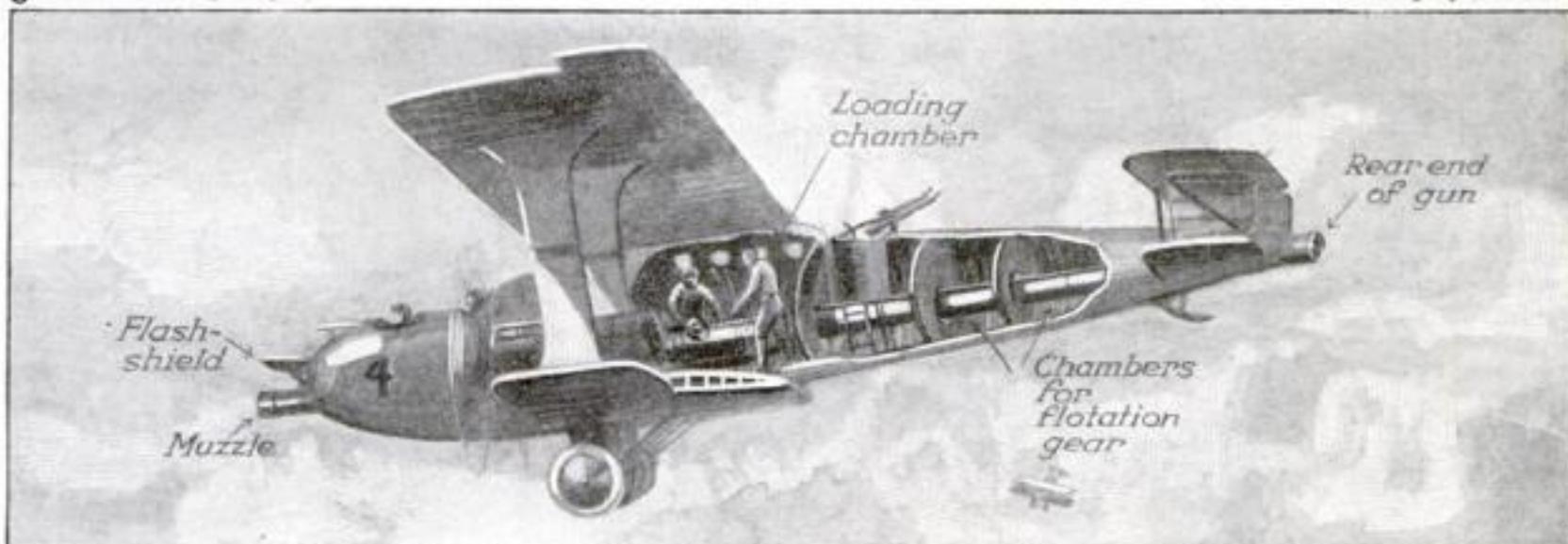
England Designs Battleplane to Carry 12-Inch Gun

Weapon with no recoil is to be built into fuselage

By P. J. Risdon, English correspondent of Popular Science Monthly

© Modern Publishing Company

Drawings by G. A. Davis



Huge battleship of the air equipped with one twelve-inch gun extending from front to rear and built into the plane as part of the fuselage, are being developed in England

DEADNAUGHTS of the air carrying guns as large as those of a modern battle cruiser comprise a late aerial development that follows close on the heels of the recent battleship-bombing tests in England and America. The gun used is the "no recoil" Davis gun on which experiments were being conducted during the later days of the war. It is the unusual principle of the gun and not the construction of the plane that makes the combination possible.

When an ordinary gun is fired, the enormous explosion that expels the projectile reacts on the gun itself with a resultant force known as the "recoil" or "kick." The heavier the shell and the more rigid the mounting, the greater the recoil.

Knowing this, it is obviously impossible to fire a rigidly mounted twelve-inch gun from an airplane in flight without totally destroying the plane. But by constructing the gun with the breach in the center and open at both ends, and filling the rear end of the barrel with finely divided material such as birdshot, the gun may be fired with no apparent recoil. The recoil is present, but it is expended in driving the fine shot from the rear end. This is the idea of the Davis gun. The range of the projectile is considerably reduced with a rifle of this design, but that matters less with a plane than with battleships and land forts.

Elimination of the recoil allowed the inventors to cut down the thickness of the gun walls and especially the rugged construction of the breech mechanism. The weight of the twelve-inch gun thus reduced makes possible its use on airplanes.

As at present designed, the airplane to carry the Davis gun will be of the monoplane type with cantilever wings stayed only from below to avoid all outside wiring. The gun itself will be mounted inside the fuselage and will extend from end to end of the streamline body. Any backwash of flame and gases after the gun has been fired will be overcome by fitting a metal nose to the machine and protecting the gun layer in the cockpit by a flash-shield similar to those used on British destroyers.

Strange to say, the big twelve-inch gun will be aimed by means of a machine gun

mounted in front of the gun layer in the cockpit and firing tracer bullets.

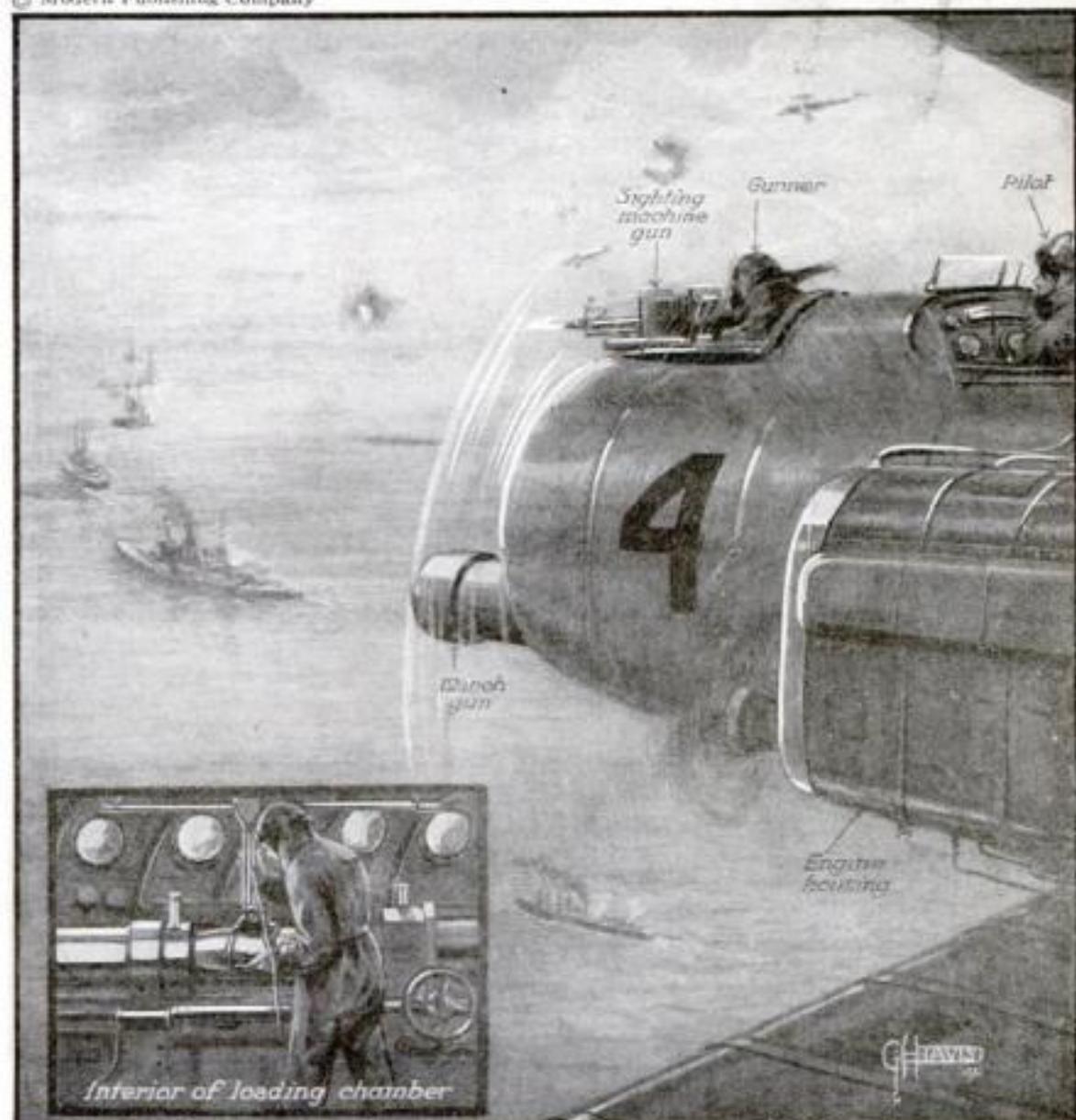
Although under normal conditions the pilot has complete command over the plane, it will be necessary to transfer this command to the gun layer during action. The duties of each member of the crew will be correlated by a complete system of telephonic communication.

Just how many twelve-inch shells can be carried on a plane has not yet been settled.

It may be that the weight of the gun will be such that the supply of heavy shells will be limited, in the same way that bombing-planes are restricted in the number of bombs that can be carried. But further development along these lines may lead to an aerial fighting unit that will demand a complete reversal of tactics when "the next war" is upon us.

Such a development as the above is but one more stride in the airplane's progress.

© Modern Publishing Company

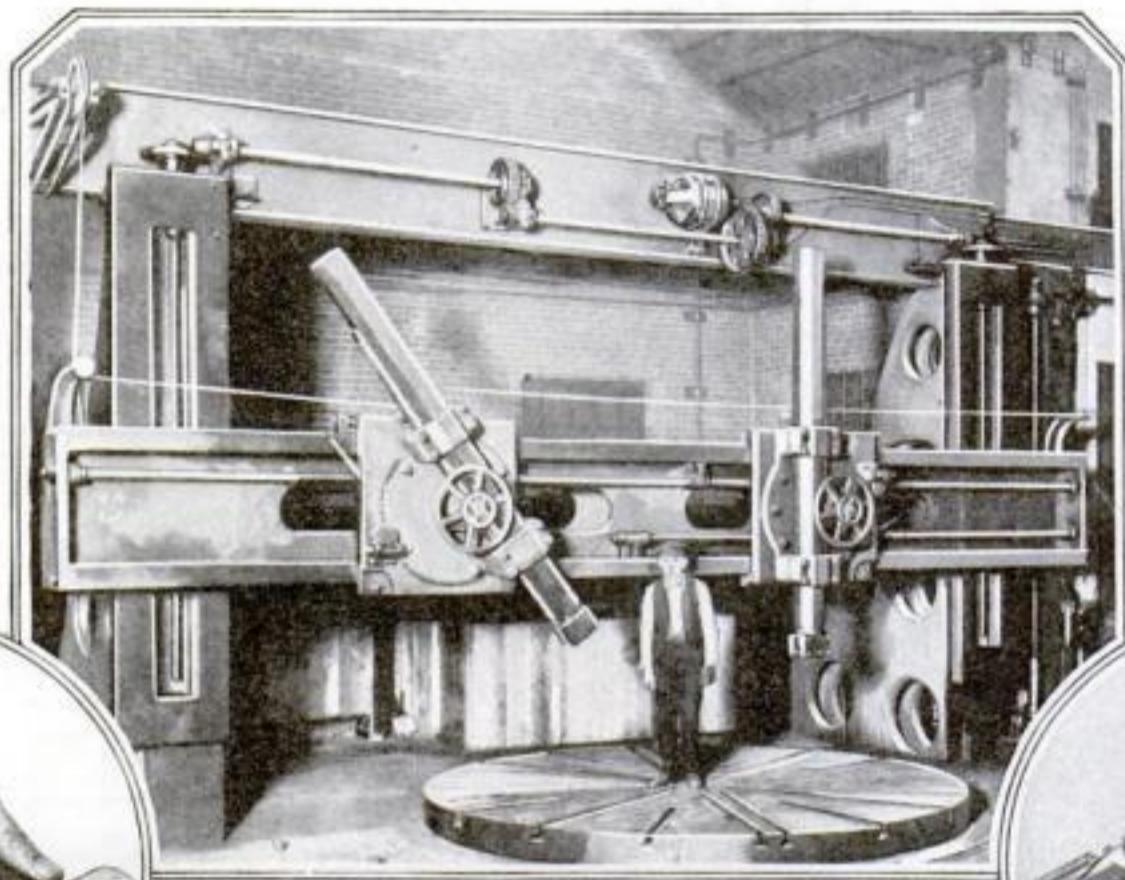


The aim of the gun will be determined by the direction of the airplane, but the accuracy will be checked up by a machine gun firing tracer bullets. The insert shows the gunner placing a shell.

Tools and Machines that Are Money-Savers in the Shop



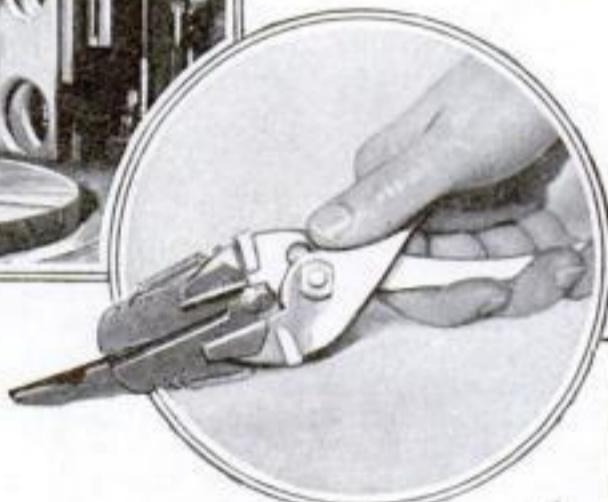
Portable drill and grinder stops automatically when not in use due to switch in handle, which opens when operator's grip is relaxed.



Vertical boring and turning mills having a twenty-two-foot swing are used in foundries and shipyards to handle large work economically. The table may be elevated to machine castings up to nine feet three inches in height.



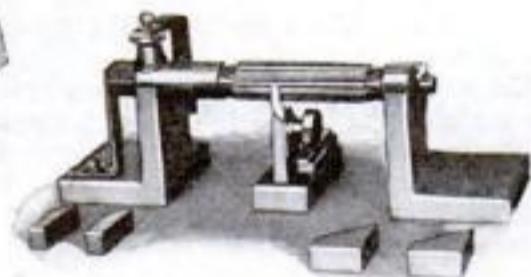
By gradually tapering the thickness of the outside cutting edge, the clearance of this cutting-off tool is maintained throughout the entire circumference.



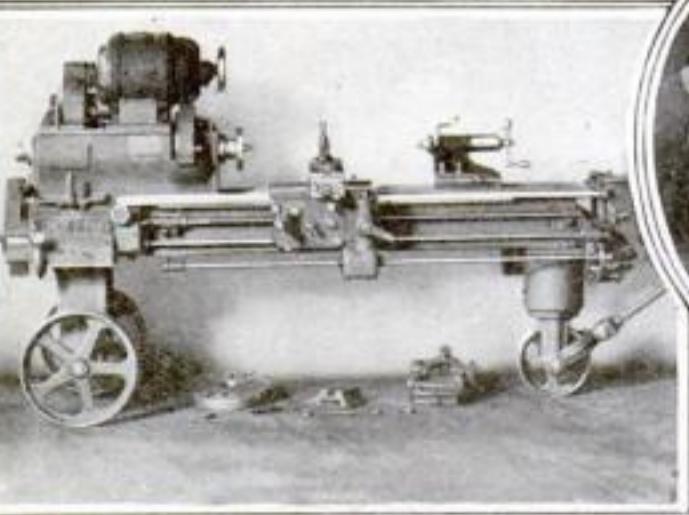
Blades clamped to the jaws of any slip-point pliers convert them into self-opening metal-cutting shears. No screws are necessary.



Keeping drills and gages in order is easy with this holder. Tools are replaced by sliding them into the V-gage. They stop opposite the proper hole.



Machine and hand expansion reamers can be ground accurately to size by this attachment, which fits the angle of any standard table.



This portable lathe can be readily hauled to any work when there is much fitting to be done on machines too bulky to move to the permanent lathe.



Garage men who have many cotter-pins to loosen will appreciate this puller, which works like a pair of pliers.



Twelve hundred holes an hour are drilled by this multiple spindle machine. Each head carries sixteen drills. Variable spindle rotation gives the correct cutting speed for each.



Folded, this device is an ordinary S wrench, but its jaws will fit nuts of any shape and size without wasting time in setting up an adjusting screw.



Fitting either flat or round terminals, this new plug will connect the electrically heated glue-pot with any current outlet in the shop.



Remote Control of Clay-Pigeon Traps

By Capt. Edward C. Crossman

AN automatic clay-bird trap that is entirely different from anything made in this country is revealed in photographs of the first trap-shoot held at the Halen See shooting grounds, near Berlin. In American parlance, an automatic trap means one that is set and pulled from the firing-line, the person in the pit merely loading it for each bird thrown, and also changing the direction of the trap from bird to bird.

A study of the battery of traps used at this big shoot develops the fact that the traps are made double with throwing arms both above and below. When one arm is forward or unset, the other arm is set ready to be released.

In the tournament at Halen See, the traps were operated from the firing-point by a set of ten wires terminating at a control board similar in many respects to the signal-control system on a railroad.

It would seem that the spring tension on the arm throwing the "bird," helps to overcome the resistance of the spring of the unset arm and a slight additional pull would then drag the unset arm around to its set position, with the spring extended and ready to throw.

The two throwing arms, upper and lower, each with its spring, are thus apparently in a state of approximate balance of spring tension. Both operating on the same vertical pivot, when the upper arm, for instance, is released and is thrown violently around by the tension of its extended spring, the tension of the spring is sufficient

to partly overcome the resistance of the lower arm spring, and a much lessened resistance to setting would be encountered. The reverse would be true when the lower arm was sprung.

The wires running to the firing-point are



The shooter does not know which of the five traps will be released from this control board

both trigger and setting wires, the trapper having only to load the trap as is done with the American automatic device.

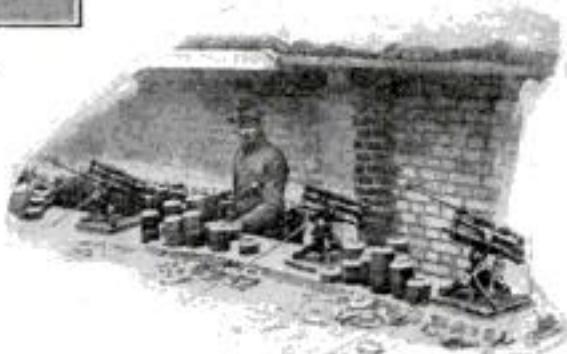
The game as played by the American sportsman calls for only one trap at a known point, but with the pigeon rising at unknown angles. The foreign trap-shooter, with his more practical idea of how to shoot clay birds, wants his targets to

rise from unknown spots as well as to fly at unknown angles. He also keeps his gun below his elbow until the moment the bird appears.

At the Halen See shoot the German sportsmen used a battery of five or more traps, set a yard or more apart, thus covering a space of at least twenty feet, from any point of which the bird may appear. The trap to be sprung is optional with the puller, but the shooter does not know which of the five it is to be.

The man controlling the traps is placed close enough to the shooter to hear and act instantly upon the command of "Pull."

In the United States the traps commonly used fall into two classes, one of which is similar to those shown in the illustration, with the exception that the double-deck feature is absent. Up to the present time, the idea of controlling the traps from remote points has not been adopted here.



Loading the automatic traps at the firing-pit before the match begins

Paper Pulp, Dyes, and Alcohol from Waste Corncobs

IOWA chemists believe they have found valuable products locked up in the lowly corncob. Bran, once a waste product of the milling industry, choking the streams that ran by the mills, is now one of America's most valuable breakfast foods. Corncobs may equal it and prove to be one of the Middle West's worth-while products.

Millions of dollars' worth of cobs that have decayed in feed lots during the last few centuries may some day be transformed into paper pulp suitable for a straw-board substitute. Some of the products that may be secured from cobs are acid tar, wood alcohol, pitch, charcoal, acetic acid, formic acid, and, lastly, furfural.

The Bureau of Chemistry of the Department of Agriculture has already succeeded in recovering furfural from corncobs, and experiments have demonstrated that it can be obtained in large quantities by certain chemical treatments. Furfural has been a comparatively rare chemical, and has been sold chiefly in small quantities for

scientific purposes. The price is about ten dollars a pound, but specialists of the United States Federal Bureau advise that it can be manufactured from corncobs at a cost of from fifteen to twenty cents a pound.

Furfural's most important present-known use is, in chemical nomenclature, as an intermediate for dyes. A whole series of dyes may be prepared by interaction with various coal-tar products. Shades covering a wide range already have been made and tested.

The United States produces from two and a half to three billion bushels of corn annually. That means about twenty million tons of cobs. It is evident, therefore,

that if all this waste product can be utilized, it will produce an enormous quantity of furfural, to say nothing of various other products.

Another Scale Pest Makes Its Appearance

THIS time it is New Orleans and the surrounding territory that is the camping-ground for a new pest. It is called the "camphor scale," but it has no compunctions against other trees such as the citrus, oak, and fig trees.

Just how or when the pest got into the United States is not known, but observations of its speed in spreading has led entomologists to believe that it arrived during the past year. Camphor scale is well known in India, China, Japan, Porto Rico, and the Philippines.

All the Government agricultural forces are active in an attempt to eradicate the pest before it spreads.



Piles of corncobs on an Iowa farm, once wasted, but now awaiting conversion into furfural and other valuable chemical by-products

Motion-Pictures Can Be Shown without Darkening Theater

A DAYLIGHT projectoscope has just been demonstrated before the French Academy of Sciences by the French inventor, M. Dussaud. The apparatus projects moving-picture films, stereopticon views, or even illustrations from a book into a well-lighted room. An improved condensing-lens and the use of



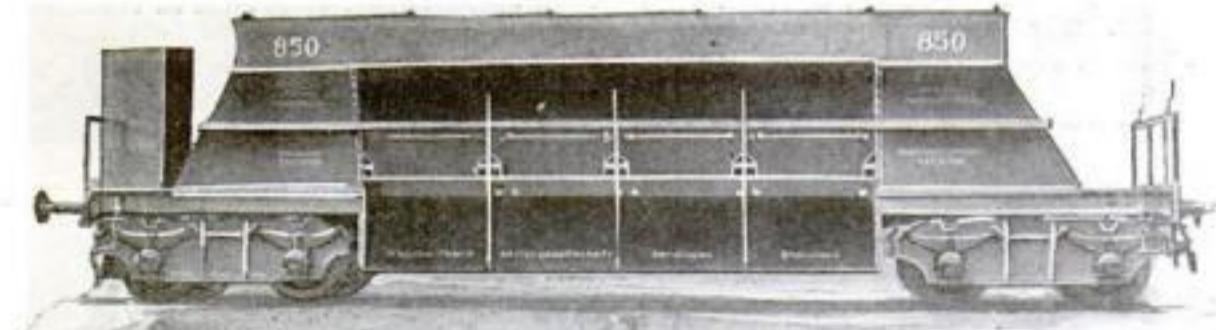
© A. N. Mirzaoff

Pictures on the wall, ceiling, or floor in daylight are possible with this projectoscope

concentrating mirrors which enlarge the image without the loss of light, permit projection without the necessity of darkening the auditorium.

THE Chief of Air Service is informed that M. Berger, a Swiss, has invented a muffler for airplane engines which does not heat up nor reduce the power of the motor, while it will allow conversation in an ordinary tone of voice between pilot and passenger. The invention is similar to an automobile muffler with the addition of a small revolving fan at the rear which aids in cooling the exhaust gases.

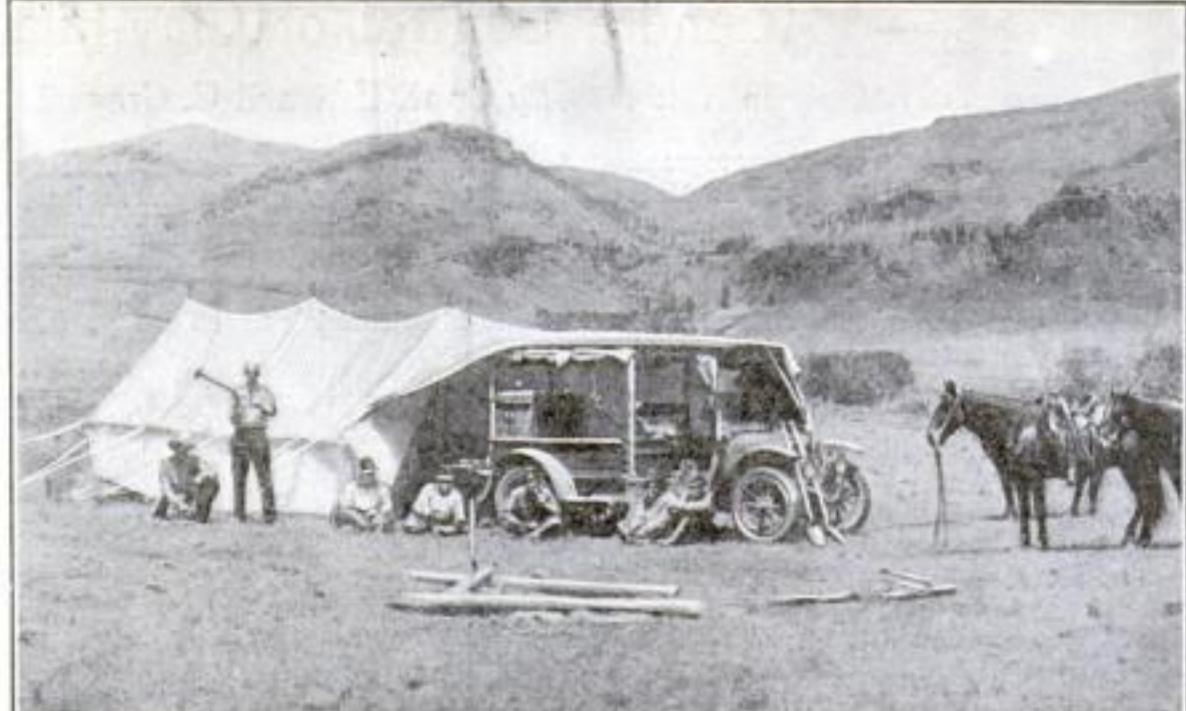
Railway-Cars that Unload Automatically



THE illustration shows a new type of ore car used by a German mine. The swinging bottom of the car is released by a lever, which unlocks easily as the load pressure of the car acts horizontally, and the several gates of the swinging bottom have hook locks that open vertically. The

lever also returns the gates to the closed position and locks them.

Another type of the car is made in which the gates close themselves after dumping, and in still another type for crate or baggage carrying, the gates have extensions to permit the boxes to slide to the track level.



Cow-Punchers Use Modern Mess-Wagon

ALMOST daily there crops up some new evidence of the versatility of motor-trucks.

During the round-up season the Pitchfork Ranch of Wyoming uses a truck to take the place of the old-time mess wagon, and, like that sturdy vehicle, it often

travels for miles straight across country where there is not a suspicion of a road, following the cow-punchers.

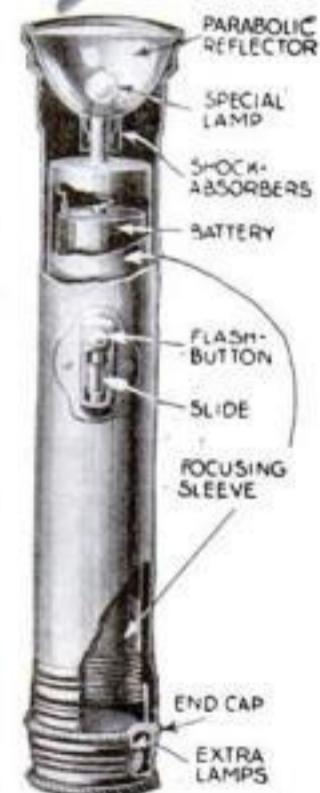
The truck carries a complete camping outfit, and delivers "all the comforts of home" wherever the boys of the outfit happen to be.



Safety-Pin for Milk-Cans

HERE is Guy S. Brewster, of Seattle, Washington, demonstrating the "safety-pin" he has recently invented.

Thousands of cans of milk are spilled daily, so Bradle devised a simple but positive lid-clamp of three pieces of spring steel, riveted together. The clamp slips over the top of the can, with the longer strip passing across the top. The shorter side strips grip the neck of the can.



An adjustable reflector makes possible a 300-foot range

New Flashlight Has Three-Hundred-Foot Range

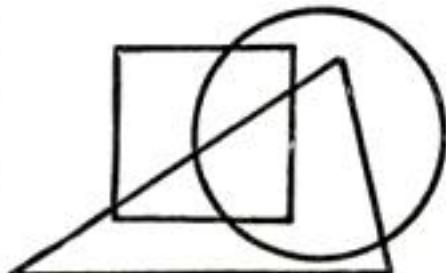
SCIENTIFIC design of the reflecting mirrors and the invention of a new form of electric-light filament have enabled a flashlight to be put on the market which will throw a clear beam of light for three hundred feet—about six times as far as a good flashlight generally carries. The reflecting mirror is made in the shape of a perfect parabola, so that all the rays leave the lamp parallel, and the bulb throws no shadow, so that every bit of the illumination is utilized.

By turning a screw at the base of the flashlight, the bulb can be moved back and forth inside the mirror. This movement, which takes the filament of the light away from the focal point of the parabolic mirror, makes it possible to throw a broad shaft of light for a short distance, lighting up a large area, or to produce a narrow beam which will render small objects clearly visible at three hundred feet. The lamp is already being adopted by many of the police departments throughout the country. The case is made watertight, and the light has been used in a pouring rain without short-circuiting.

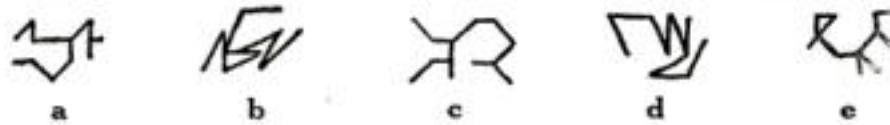
As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly.

19304

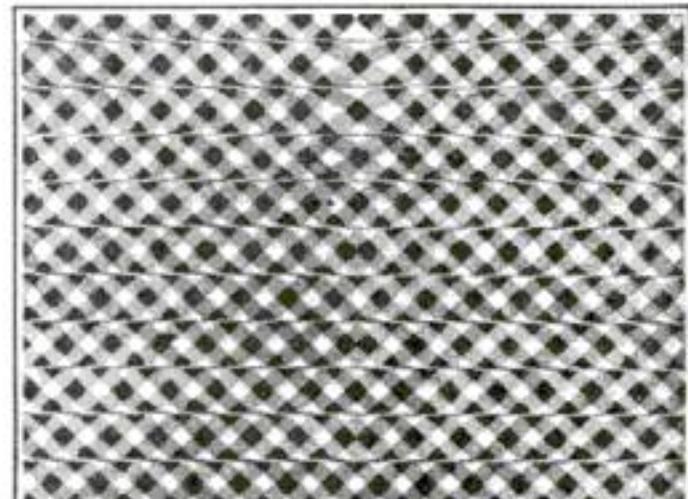
Can You Get These Eye-Testers Right in Less than a Minute?



1. Copy this diagram quickly in freehand; then make a figure 1 in the space that is in the circle, but not in the triangle or square. Also make a figure 2 in the space that is in the triangle and circle, but not in the square.



Find each one of these designs in the set below, and write down its location, as specified in caption No. 4. This test and the one at the left are reproduced through the courtesy of Prof. Edward L. Thorndike



3. Of the transverse lines that are shown running from margin to margin in the above drawing, how many curve upward?

HOW quick are your eyes? How alert are your brain cells? Do illusions fool you?

Find out by trying these famous intelligence tests. They will make instructive recreation for a winter evening's gathering. Pass around slips of paper with spaces numbered 1, 2, 3, and 4. Let each person jot down in these spaces the answers to the questions contained in the numbered captions. Keep a stop watch on each contestant. Correctness of answer, as well as speed, counts in picking the winner.



2. Which of the two inner squares in the above drawing is larger, the white or the black?

Explanation: Although of the same size, the white square appears larger than the black one, due to irradiation, that makes the borders of clear surfaces indistinct so that they seem to extend beyond their limits on to any darker surface that may surround them.



4. Glance at each of the five figures lettered a, b, c, d, and e at the top of the page. Then find its counterpart in these columns. When found, indicate its location by setting down the letter it bears at the top of the page and the number it bears in these columns, in this style—f-26

The Engineer Gets His Orders



THIS ingenious mechanical contrivance is used to deliver orders between the locomotive engineers and the switchmen as the trains of the Midland & Great Northern Railway in England enter a section of single track running between Spalding and Lynn. Orders are issued at every siding telling the engineer to proceed or to draw out and allow another train already on the section to pass. Formerly this was done by hand, which forced the trains to slow down and occasionally resulted in messages being missed. The mechanical despatcher is con-

structed along the lines of the automatic device by which American trains pick up bags of mail at way stations without reducing speed. The messages are placed in the small bag, and an iron arm projecting from the engine cab trips the catch and picks up the bag by hooking into the iron ring. The picture shows a switchman recovering a message dropped by a passing locomotive.

Making Heat Instantly with Chemicals

A METAL hot-water bag that contains no hot water but that is heated by admitting air to a chemical compound contained inside the case is now on the market. Its action is extremely simple. When the stopper is unscrewed for a fraction of a second, the bottle becomes warm, and will remain so for from eight to twelve hours.

Many chemical compounds liberate much heat. Every one has seen the water boil when plasterers mix it with quicklime, but no water at all is used in this device. The chemicals are harmless, may be handled safely, and the bottle will not explode. The instant heat produced without the trouble involved in lighting a fire will be appreciated on camping-trips and in household emergencies.

Seed Potatoes Cut by Machine



IT is no small job cutting up seed potatoes for planting on a big truck-farm, but a great deal of labor is eliminated by a machine recently devised by John O. Jacobson, of Nelsville, Minnesota.

A plunger pushes one potato at a time against a cross-shaped stationary cutter. A movable cutter cuts the same potato across the cuts of the stationary slicer.

When an extra large potato rolls into the slicer, it acts on a knife-spreader that causes the blades to make two cuts instead of one. The device is operated by a motor.



Measuring and Recording Rain- and Snow-Fall

HOW many inches of snow fell by ten o'clock last night, is a question that need no longer be answered by a guess. A recording rain-gage, designed by S. P. Ferguson, meteorologist of the United States Weather Bureau, weighs the total fall of rain, snow, hail, and other solid forms of precipitation at any instant during the progress of the storm, no matter what its nature.

The operating mechanism is essentially a spring balance. Rain or snow falling into the self-contained compartment at the top of the device depresses the spring, and the pen attached to the recording lever makes an upward trace on a cylinder around which is wound a sheet of paper ruled horizontally in inches and tenths of inches and vertically in hours and fractions thereof.

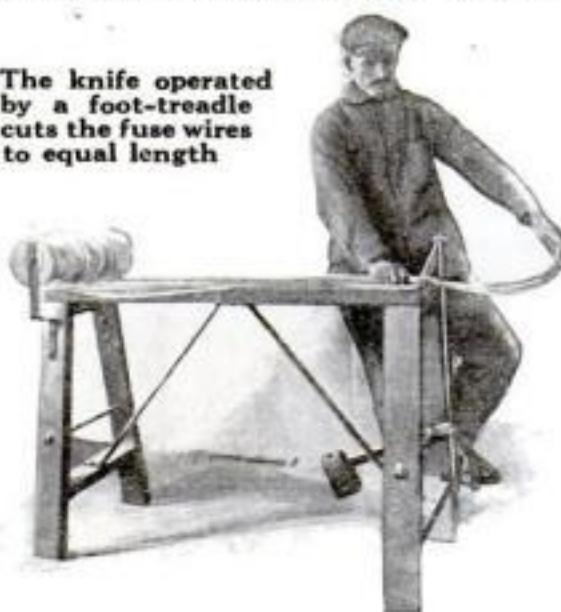
This scale of measurement permits the precipitation during any hour of the day to be determined without any necessity for an observer to read the scale. The cylinder just referred to is rotated once in twenty-four hours by a clock with which it is connected by means of a carefully adjusted shaft and gearing.

Blasting-Fuses Cut to Safe Measure by Machine

MANY mine accidents are caused by carelessly cut fuses. It is the common practice to cut them by hand one length at a time, and as a result a fuse, intended to allow the miners a certain length of time to seek cover, would explode earlier. These premature explosions never failed to take their toll in lives.

A practical miner, has now designed and built the fuse-cutting machine shown in the illustration, which consists of a removable spool secured to one length of a bench about five feet in length and one foot in width. The spool has a capacity of five hundred feet of fuse. At the other end of the bench is mounted a knife, one end stationary, the other operated up and down by a foot lever, which is counterweighted to return it to cutting position. Measur-

1931
The knife operated by a foot-treadle cuts the fuse wires to equal length



ing marks are placed two and three feet from the knife.

The machine is used at all the mines of the New Jersey Zinc Company. In one mine using six thousand feet of fuse a day, this machine saves the work of four men.

Huge Battery of Flood Lights Illuminates Skyscraper



1931
THE illustration shows the Wrigley Building in Chicago, as it is displayed by the light of 214 projectors, producing nearly five million candlepower. The lights themselves are located on the roofs of neighboring buildings and are invisible from the street. The cost of installation of this flood lighting was about \$30,000, and the total expenditure for maintenance is about eighty dollars a night.

The Saidy Date Must Go to Quarantine

EARLY in 1920, Professor S. C. Mason, of the Bureau of Plant Industry, went to Egypt to get offshoots of the Saidy date, for the purpose of experimenting with its growth in the United States.

The Professor brought back about eighteen hundred offshoots—from the Libyan Desert, the neighborhood of Cairo, and the Nile valley.

Although many of the date shoots have struck root and are ready to be set out in orchards, the Bureau will not distribute them to growers because the trees have developed infection with two dangerous scale insects—the *Parlatoria* and the *Phoenicoccus*. In consequence, the trees must be kept in quarantine for many years to insure the utter destruction of the pests.



Sword-Swallowing Made Possible

1931
BEHIND all sleight-of-hand tricks there is usually a scientific manipulation that makes the trick possible. The sword-swallower of China, represented in the illustration as about to devour the sword, is no exception. The sword he is swallowing is keen and highly tempered, but a mechanical device in the handle allows the blade to slide back as the hilt passes into the conjurer's mouth. The point is held against the teeth, as the lips draw the handle inward.

The snake-charmers of India likewise have their tricks of science, unnoticed to the spellbound audience, but absolutely necessary as part of their stunt.

Combined Handle-Bar and Package-Carrier

1931
SEVENTY-EIGHT pounds of stone is a heavy and awkward load to carry on a bicycle, and it is possible only through the logical design of the handle-bar and carrier basket illustrated. This enables the load to be perfectly balanced over the axle of the

The load can be handled easier when the carrier becomes the handle-bar



front wheel. Handle-grips are fitted in the side of the twenty-two-inch basket.

Ample knee room is provided, and the whole carrier is made so that it can be installed in any standard seven-eighth-inch handle-bar socket.

The advantages claimed are that the load cannot joggle nor sag. The basket is of heavy gage woven wire of one-and-one-half-inch mesh over a three-eighth-inch frame, and cannot be pulled out of shape by any load which a boy can lift on to a bicycle. The handle-grips are of coiled wire, and are boxed to give plenty of room for the fingers.



Electricity Heats Water as It Passes through Faucet

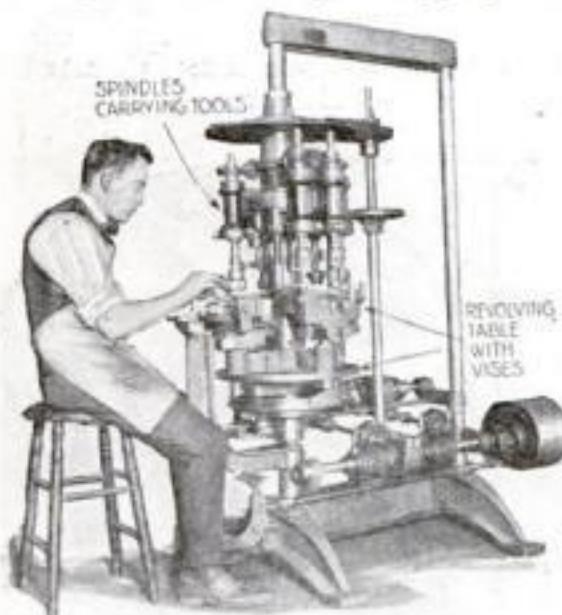
BY means of an electric resistance coil nearly a foot long placed in the center of the water-pipe, this faucet will supply hot water at the rate of thirty gallons an hour. Its action is instantaneous, and there are no switches to turn, since moving the faucet handle to the left starts the electric current.

A separate circuit of No. 14 wire must be used, as, like all electric water heaters, the amperage consumed would burn out the switches of a lamp socket, but the invention should be a boon to mercantile establishments handling unwrapped food. Although these use little hot water, the law requires that it shall be available at all times, and this electric precludes all danger of explosions and does not waste money by heating water which will never be used.

Machine Makes Five Operations on One Piece of Work

THIS is another time-saving machine that will do as many as five operations on one piece of work.

Five revolving tables are provided with vises. Each of the five vises holds a tool for a certain operation; such as reaming, drilling, countersinking, or tapping. The



After performing five different operations, this machine automatically ejects the piece of work

small vises on the revolving table hold the work and bring it under the tools progressively.

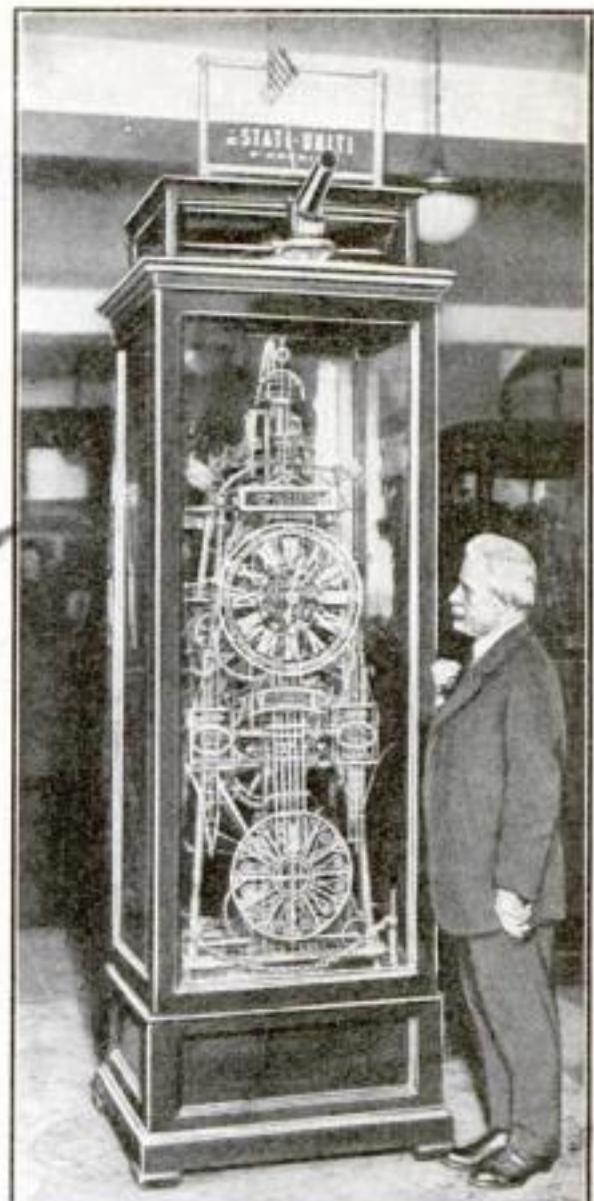
When an operation is completed on one piece, the table revolves and the work is advanced to the next tool, and so on, until the complete circuit is made.

Bamboo Clock Tells the Day, Week, Month, and Year

EVEN the springs and the wheels of this eight-day pendulum clock were carved from bamboo with a penknife. With the exception of a ten-pound leaden weight which operates it and two small glasses which serve as gongs, the entire mechanism is constructed of cane such as is found in the ordinary bamboo fishing-pole. Its inventor and maker, Constance Renzi, a sixty-year-old clockmaker of Rome, spent the last two years whittling out the complicated works to show what Italian workmanship could accomplish with the crudest materials. He declares he could make a second clock in two months.

The clock tells the hour, minute, and second, the day of the week, the month, and the year. It shows the phases of the moon, and strikes the hours and quarter hours, while an alarm activated by a bamboo spring will get its owner up in the morning. At noon, if desired, the works can be set so that a small flag is run up to the masthead, the raising being preceded by a whistle from a bamboo tube, and one minute after the noon hour the cannon at the top of the clock is discharged.

An exceedingly clever method is used to prevent the escapement from wearing out. The escapement jaws engage spokes on a large wheel, and these spokes revolve loosely on bamboo pins, constantly presenting a new surface to the wear. As bamboo is covered by an extremely hard siliceous coating, the clock will run for years, and comparison with ordinary clocks shows that it keeps excellent time. Mr. Renzi has already refused an offer of eight thousand dollars for his clock, which he hopes to sell to a museum.



Mr. Renzi used nothing but bamboo in making his eight-day clock



Pockets for Woman—in Her Hat!

OLD-FASHIONED lawyers used to carry their wits and pleadings in the crown of a battered hat, also a plug of tobacco, perhaps, and a bandana handkerchief.

Note how the woman of 1921 revives this ancient method of "stashing" pocket things. Two customers of Peggy Hoyt, well-known New York milliner, were found on the exclusive Shinnecock golf-course at Southampton, Long Island, with amethyst-colored sports hats that had folds specially designed to carry a cigarette-case, vanity mirror, and powder-puff—and the photograph shows them about to be demonstrated.

In one hat the necessities are merely slipped in and out of the folds, while in the other there is a flap with a snap-fastener.

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly

Combination Chair and Umbrella Makes Artists More Comfortable

COMPRISING everything an artist requires for an afternoon's sketching, with the exception of the proper light and inspiration, the entire outfit weighs only six pounds. Folded, this camp-chair can



A combination chair, sunshade, and portfolio of sketching tools for the rambling artist

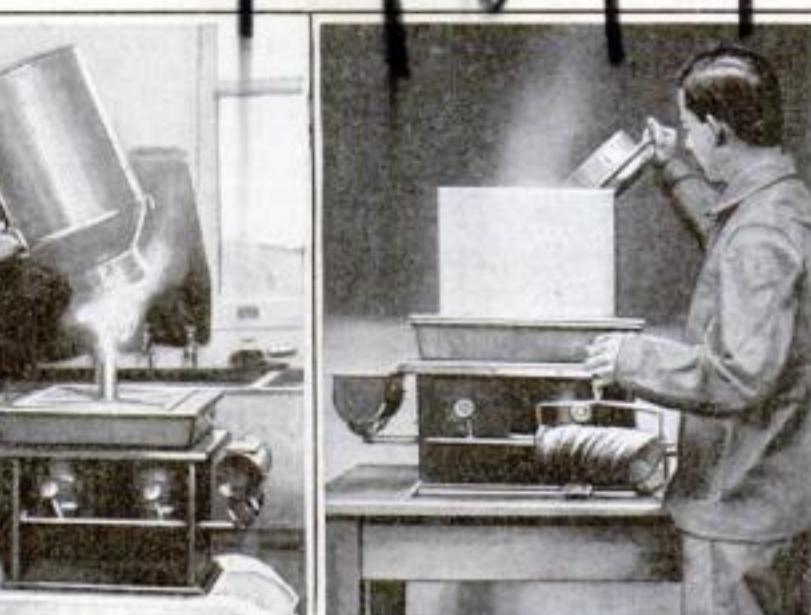
be carried easily in the hand or swung on to the back; open, and the artist has a jointed umbrella to keep off the sun, a mirror by which he may watch the country behind him and guard against the irate farmer who has sworn vengeance on the trespasser, a graduated rule for laying off his drawings, an eraser, which also serves as a plumb-bob, a bottle holding water for water-colors, and a waterproof bag to contain all these accessories while on the march.

Simple, Homemade Sterilizer for the Dairymen

A ROASTING-PAN, a galvanized iron cover with a spout soldered in the center, a metal box, and an oilstove—all articles which can be bought at any hardware store or easily constructed at home—comprise a complete outfit for sterilizing dairy utensils by steam.

This simple method of sterilization has been worked out by the United States Department of Agriculture, which describes the manner of operation as follows:

The cans should be thoroughly cleaned and rinsed with washing powder, hot water, and a scrubbing-brush before they are ready for sterilizing. When they no longer feel oily or greasy, arrange the apparatus as the illustration indicates, and test the heat of the steam escaping through the spout with a thermometer. When this registers at least 205° F., put the can over the spout, and leave it there for five minutes. Use gloves



A milkcan placed over this spout of live steam is made absolutely sterile in five minutes

A galvanized box supplies the sterilizing chamber for cream-separator parts

to remove the can, as it will be too hot to touch, let it drain five seconds, and then set it on the floor, mouth up. Within two or three minutes it will be perfectly dry, owing to the intense heat to which it has been subjected, and all bacteria will have been killed. The smaller implements are ster-

ilized the same way, using the galvanized box.

This outfit can be provided at a cost of from ten to fifteen dollars, including the kerosene stove. The equipment of the usual small dairy can be thoroughly sterilized in forty minutes, and in addition to a more sanitary product, the use of sterilized utensils will keep milk fresh for a longer time.

Dishes or implements that are clean are not necessarily free from bacteria. Even milk that has been produced under the closest scrutiny and with perfect cleanliness contains a few bacteria. Every time that milk or milk-

containers are handled, a certain number of bacteria are added and it is only by sterilization at 212 degrees that these bacteria and germs can be killed.

Realizing that the usual equipment was too bulky and complicated, the Department of Agriculture perfected this simple sterilizer.



Miles away the words written by this man will be reproduced automatically on sensitized paper

Write a Personal Message by Telephone

WRITING with a lead-pencil at one station and reproducing the handwriting at another place is in itself nothing new, but when the reproduction is accomplished by a minute beam of light acting on photographic paper, it is worth mentioning. The illustration shows the sending station of an apparatus of this nature.

The sender simply writes down whatever he wishes to send on the roll of paper passing through his machine. Ten seconds later the message has been imprinted on a strip of sensitive paper and developed automatically in the receiving device. The apparatus may be used over any telephone or telegraph line already existing.

MOST "French" briar pipes actually come from Corsica. The Sicilian briar-root is considered the best.

Spectroscope Detects Minute Bloodstains

BY the newest spectroscopic methods of analysis, one five hundred thousandth part of a drop of blood on a criminal's clothing is enough to convict him of murder.

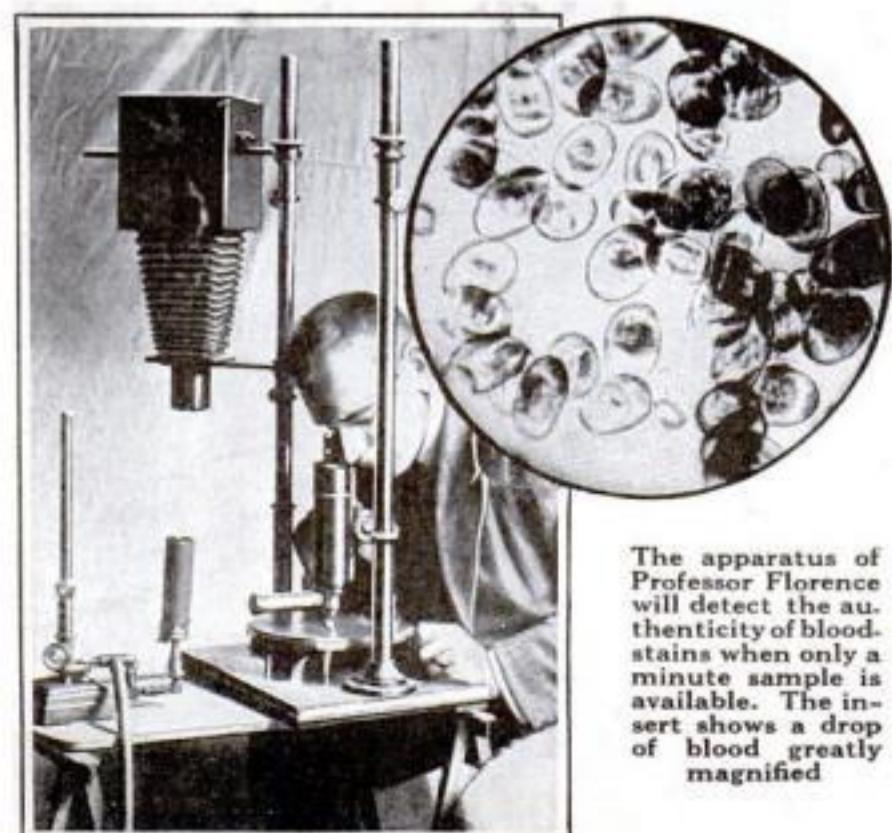
With the new system perfected by Professor Florence, of Lyons, France, the smaller the amount of blood, the more certain and easy is its recognition. This is of immense advantage to criminologists, since when sharp weapons are withdrawn from a wound they are usually wiped clean of all but an infinitesimal amount of blood by the victim's clothing, and the detection of the presence of human blood on the suspect's knife is often impossible by chemical methods.

Professor Florence makes photographs of the spectrum of blood, or of the blood corpuscles themselves while they remain on the object examined, so that if need be, the jury need not credit the testimony of the expert, but can repeat the tests for themselves. His apparatus consists of a microspectrope in which a powerful beam of light is directed through the horizontal tube at the left on to the knife-blade beneath.

When the scientist discovers a blood-stain, it is readily photographed by swinging the camera at the left into position over the microscope. Examination of the size and shape of the blood corpuscles determines whether or not the stain is that of a human or of an animal.

The camera is so constructed that the degree of enlargement of the blood corpuscles may be varied at will without changing the focus of the microscope. Sometimes, however, the form of the corpuscles has been destroyed, and in these cases a spectroscope is used to afford positive identification.

With this method bloodstains scarcely to be seen on colored fabrics can be recognized. In one test, a single bloody thread, only 0.04 of an inch long, was placed under the microscope and treated with Virchow's fluid mixed with a little honey to remove the dye and brighten the color of the blood-stain. Instantly the spectrum of hematin, characteristic of blood, appeared under the microscope—a complete proof of a crime, although only one five hundred thousandth part of a drop of blood was present.



The apparatus of Professor Florence will detect the authenticity of bloodstains when only a minute sample is available. The insert shows a drop of blood greatly magnified



Indian Folk-Songs Are Preserved by the Government

SONGS for burial, for marriage, and for birth, in fact, for every important occasion that arises in his life, are the kind of songs sung by the American Indian.

Some of these songs had their beginnings when the Indian was master of the American continent.

Eventually the red man will be of the past, and so the United States Government is now having phonograph records made of the old Indian songs. That is what the splendid-looking Indian in the picture is doing—canning his tribal songs.

Dark Stranger Appears in Space

AN astounding discovery by a Dutch scientist of a heavenly body twenty million times larger than the sun has introduced a new factor into astronomical circles.

It is thought that the body is a huge cloud of dust that will eventually become a star. Measurements made of the dark mass show it to be 140,000,000,000 miles long and twice that far away from the earth.

Delivering Beer with a Hose

UNFORTUNATELY, this chap is not delivering gasoline through the hose, but beer; still more unfortunately, he is delivering it in the British Isles. A scarcity of wooden kegs compelled the brewers to distribute Budweiser in tank-cars and motor-lorries.

There was considerable complaint from those who feared the flavor of the beer would be spoiled by contact with galvanized iron and rubber, but these fears proved unfounded.

The second hose on the rear of the wagon is used to deliver light beer. The tank is divided into two sections, and the other hose will be used as soon as this "public house" has been supplied with all the dark beer its patrons are likely to require.



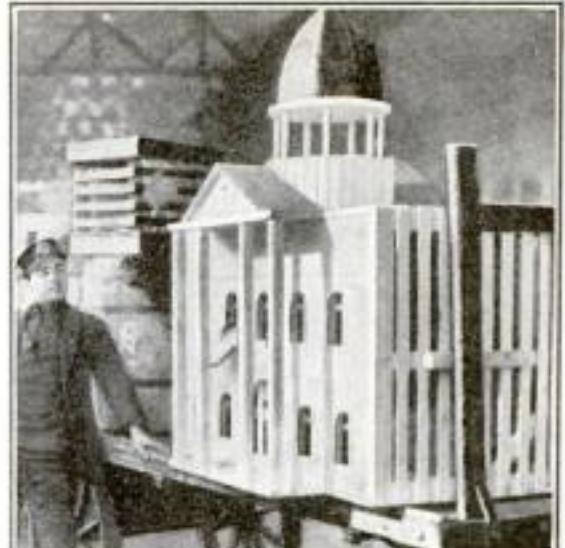
Special compartmented metal tanks mounted on trucks are used to deliver beer in Great Britain

Odd Items of Interest from Around the World



Man-Propelled Trolley in East Africa

MOMBASA, in British East Africa, can show the foreign visitor a unique system of man-propelled trolleys that are deficient in speed but with compensations such as cushioned travel and an unobstructed view. A covering, such as seen on a baby's perambulator, shades the rider.



No Contest to Occupy This White House

EVERY year the biggest turkey is shipped to the White House for the President's Christmas dinner by the town or county that has raised the heaviest and finest bird, and this is the crate, in the form of a White House, in which the bird is shipped.

There is no higher honor to which a turkey can aspire than to become the tenant of this crate. It marks him as the finest specimen in the land; but in spite of the distinction conferred, no turkey has as yet appeared eager for the nomination.

Moving Roadway for Japan

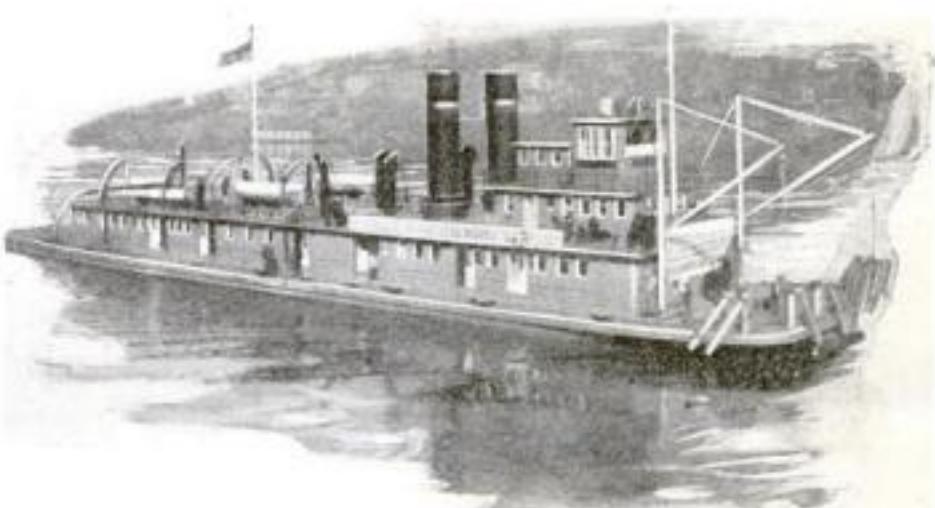
JIROZAKA Hill in Yokohama, Japan, separates the exclusive foreign colony from the shopping district and presents a serious obstacle to motor-cars and rickshamen.

The city authorities have been asked for permission to construct a moving roadway leading over the hill. A Japanese engineer thought of the idea, and purposes to operate the road by electricity, charging toll of all vehicles that use it.

Shallow Draft Towboat for the Mississippi

THE *Natchez* is the most powerful river towboat ever constructed in this country or abroad. She will tow six steel barges, each 230 feet long by 45 feet beam with a maximum carrying capacity of 2000 tons. She is built of steel and equipped with oil-fuel boilers and two triple expansion engines.

As the river is shallow at some points, the twin screws are set in tunnels built in the bottom of the ship, so that they cannot foul if the ship grounds on a sandbank. The flow of water to the propellers is unhindered, and four rudders, one placed both forward and aft of each propeller, make the maneuvering qualities of the *Natchez* excellent, and she can run full steam ahead in water as low as seven feet.



The largest river towboat in the world has twin propellers revolving in tunnels to prevent fouling in shallow waters

19305

From Ore to Capsule—

Striking picture of the little known process of

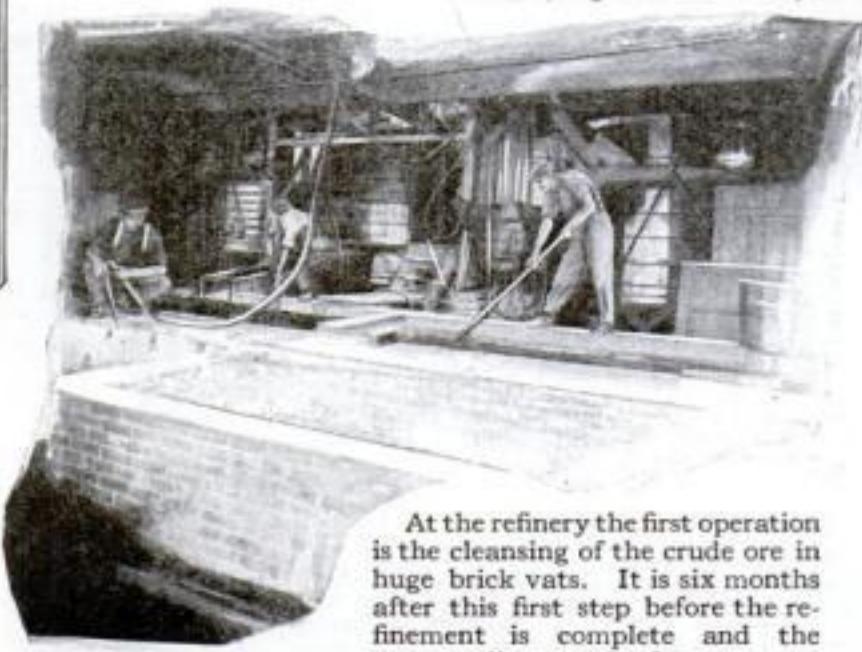
Photographs © U. S. Radium Corporation



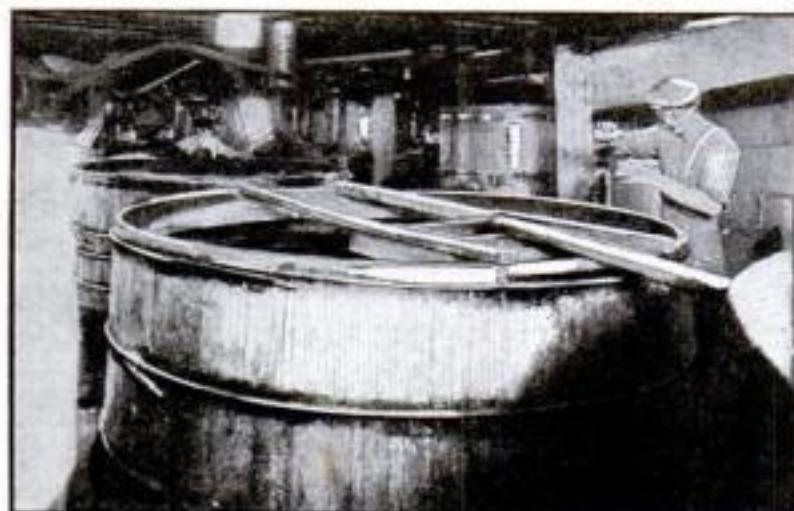
Carnotite ore, from which radium is obtained, is mined principally in Paradox Valley, New Mexico. The ore is placed in sacks and carried in teams over the rough country to the railroad. It requires about six hundred tons of carnotite ore to produce one gram of radium.



During the refining process other valuable products, such as uranium and vanadium, are extracted from the ore by chemical treatment. Vanadium is an important element in steel manufacture.



At the refinery the first operation is the cleansing of the crude ore in huge brick vats. It is six months after this first step before the refinement is complete and the radium ready for use.



The solution containing barium and radium salts in the ratio of ten parts of radium to a billion is treated with sulphates to precipitate an insoluble "raw sulphate of barium."

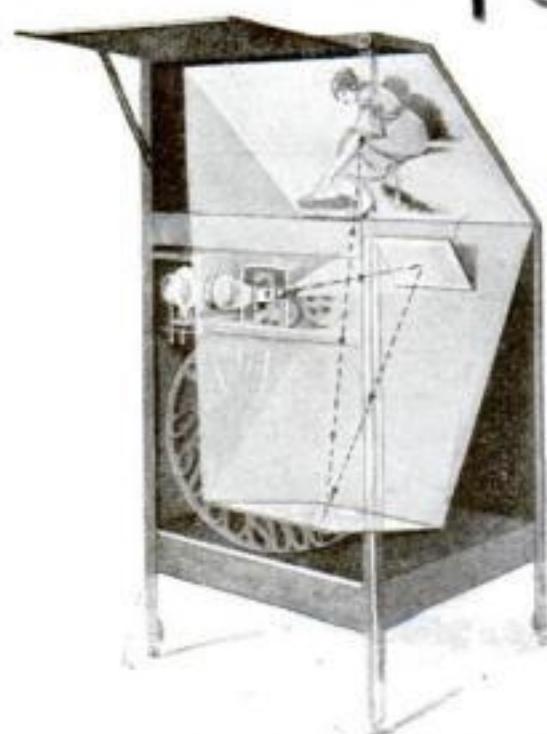
Film-Projector and Screen in the Same Cabinet

PICTURED here is a motion-picture projector that includes within one cabinet the necessary film-storage space and the

screen for showing the picture. A unique arrangement of prisms makes it possible for the picture to be projected outside the cabinet and on to a larger screen set at a distance for home use.

Perhaps the most interesting feature about this cabinet is the method by which the film is stored so that by connecting the two ends correctly the film may be run continuously as long as desired. A special safety device stops the motor driving the machine when the film breaks.

The projector consists of the usual incandescent lamp, intermittent movement revolving shutter and projecting lens. A steel fireproof cabinet is furnished for the safe storage of the film.



The film is projected on to a screen set into the cover of the cabinet

Rolling Desk for the Use of Crippled Children

THERE are so many crippled children in our classrooms—in New York city alone seventeen hundred must be taken to school daily by automobile—that a special movable desk, shown in the picture at the right, has been designed to permit children unable to walk to participate to some ex-

tent in the regular school activities of their classmates.

The desk, or chair, has a special support for the legs, and can be adjusted in every direction so that the child can rest in the most comfortable position.



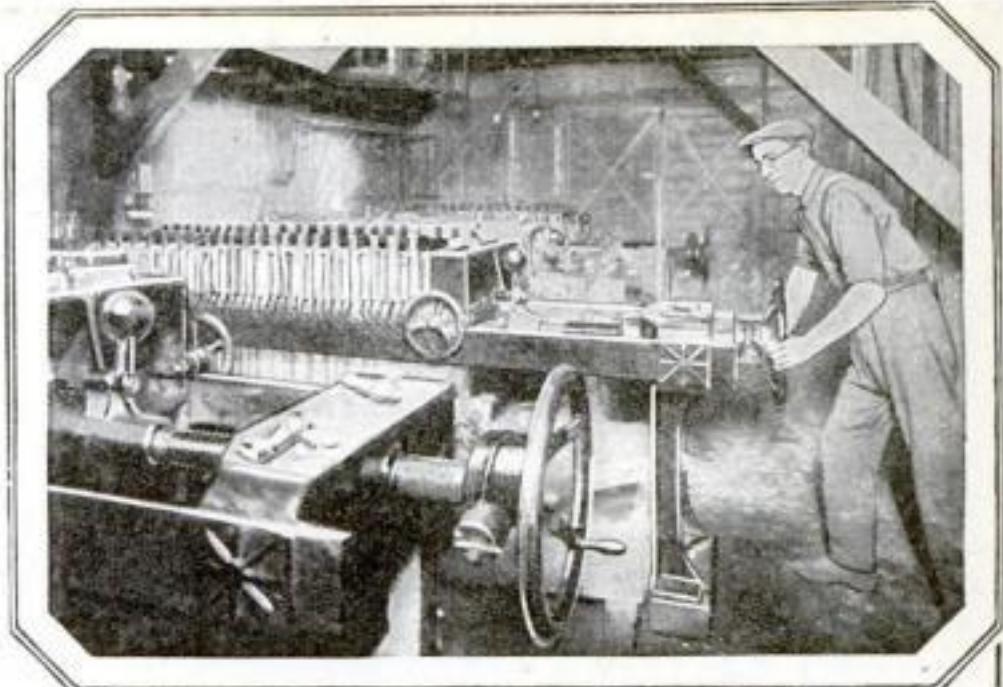
With this rolling desk crippled children can attend schools without discomfort.

The History of Radium

refining six hundred tons of ore to a gram of radium



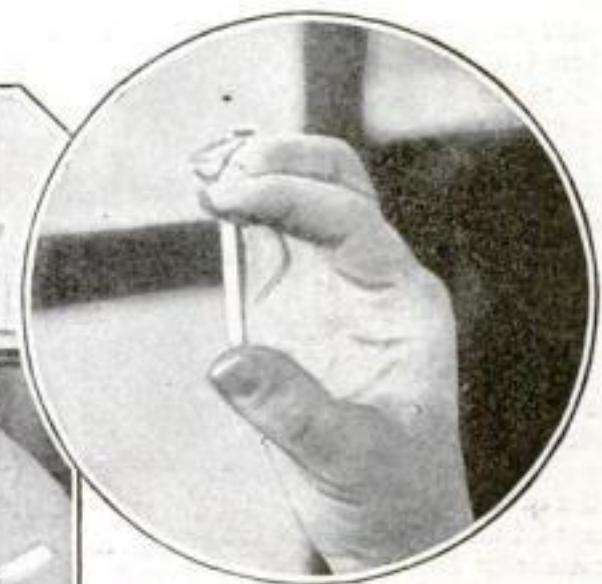
From the filter presses the liquid containing radium is placed in crucibles over burners and carefully evaporated. In the room shown above the chemists have more than \$500,000 worth of radium.



The fluid from the chemical vats is run into filter presses and compressed between sheets of chamois-skin. As the liquid runs out it is tested for its percentage of radium



The four tiny crucibles contain the radium extracted from the original six hundred tons of ore. It has required the labor of five hundred men for six months



The finished gram of radium, worth \$120,000. In its pure state this sample of radium will remain active, giving off its emanations for approximately 1780 years

Purdue Has World's Largest Bass Drum



MIT is seven feet high and four feet from drumhead to drumhead. It is wheeled along on a little carrier during parade. When mounted on this the top is nine feet from the ground. The tone is deep and rather subdued, but it has a wonderful volume and resonant power that make this drum able to balance the most strenuous efforts of a 125-piece brass band.

The world's largest drum was not constructed without difficulty. It took several

months to find two bull hides large enough for the heads, which are one hundred inches in diameter. Such heads put a great strain on the shell, which required special reinforcing and a novel type of screw-rod manipulators for varying the tension of the heads. After the instrument was completed, it was found that the doors of the ordinary baggage-car are not large enough to admit it, and a special car will be necessary when the band goes on tour.

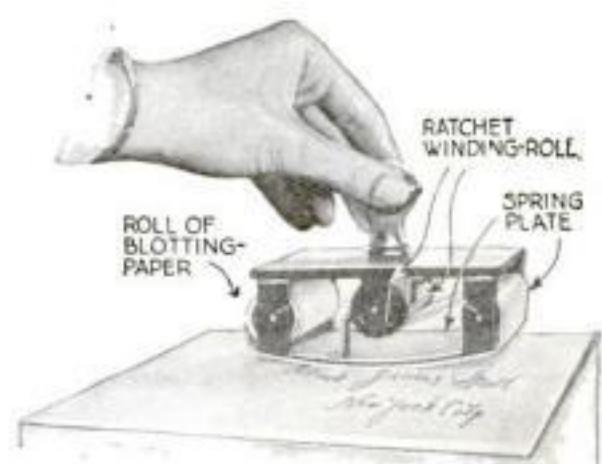
Pontoons to Replace Ferries

PONTOON bridges across Lake Washington have been proposed to relieve congestion on the ferries of Seattle. Fifteen wooden vessels constructed for the United States Shipping Board would be used as floats, and upon them an eighteen-foot roadway and two four-foot sidewalks would be constructed. Drawbridges would be provided to permit navigation.

As a special service to readers, the Editor will be glad to supply the names and the addresses of manufacturers of devices mentioned in Popular Science Monthly

Renews Blotting Surface after Each Operation

A BLOTTING-STAMP has been invented in Germany that constantly renews itself. Thin blotting-paper on a spool covers the bottom of the stamp and rewinds around an idler. Each time the stamp is pressed down, it pushes a little pawl that trips a ratchet gear, winding up the idler.



A ratchet mechanism renews the blotting surface each time the blotter is used



Shoes for Equine Bog-Trotters

A ROUNDED wooden plank about one inch thick, fitted with staples and springs that fasten it firmly to a horse's hoof, has proved useful when teams must be driven over soft bogs or loose sand. The horse puts his foot in the center of the plank, and when the clamps are fastened as indicated in the illustration, he may walk wherever he chooses without sinking into the soft soil.

DOES a coral island grow from the top down or from the bottom up? An American professor is leading an expedition to the South Seas to settle the question. Darwin stated that the coral grew naturally from the bottom, but recent scientists contend differently, hence the expedition. Coral is a substance secreted by the marine polyps.

Hand Fire-Extinguisher Uses No Liquid

POWDERED carbonate of soda and carbon dioxide gas are blown over a fire by this extinguisher, patented in Germany. The chemicals are dry, and no water or sulphuric acid is used. The result is a great reduction in weight without loss of efficiency.

The gas is compressed in a strong container. When the valve is opened, the gas is blown through the powdered soda, and the mixture blankets a fire without the danger of short circuiting electric wiring, which is the drawback of the liquid soda apparatus. In the test illustrated, a wooden structure, smeared with benzine and tar and burning furiously, was extinguished in ten seconds.



Curtain of Water Safeguards Books

EXTERNAL sprinkler systems have been installed along the eaves of the Chicago Public Library to protect the priceless volumes in the building from the danger of fire. In case a blaze starts in any of the structures near by, a wall of water falls from the roof of the library, extinguishing flying sparks and protecting the building against heat and smoke.

Disk Improves Phonograph Tone

CLEARER tone, a purer musical quality, and the total elimination of all scratching and scraping noises are claimed for this phonograph attachment. It consists of a round ball into which the needle fits, with only about a thirty-second of an inch of the tip protruding. The ball rests on the surface of the record. The disk is arranged parallel with the record.

In this way the incidental vibrations imparted to the needle by dust in the groove or a worn path, are dissipated before they reach the reproducer, while the vibrations are passed undampened. The music produced is not loud, but sweet and clear.

FEWER people are dying this year, according to the Metropolitan Life Insurance Company, the death rate being 23 per cent below that for 1920.

Building-Blocks Made on Continuous Molder

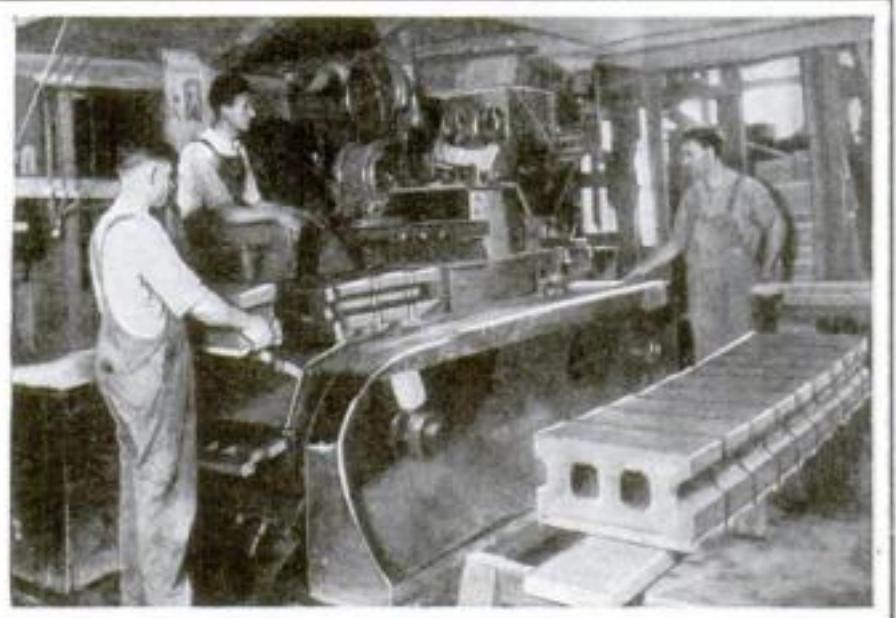
INVENTED by George C. Debay, of Springdale, Pennsylvania, this machine forms blocks accurately and rapidly at greatly reduced cost. The molding parts are carried on an endless conveyor. Each member forms the bottom and one side of the mold.

The upper portion of the side of the mold member is made in movable sections. A side of the core-bar adapted to engage an opening formed in the sides is provided, whereby the sections may be swung into position over the core-bar to enclose same.

Plastic material is fed to the molds through a spiral conveyor.



Dry chemicals instead of liquids compose this fire-extinguisher. The gas carries the powder to all parts of the blaze and smothers it.

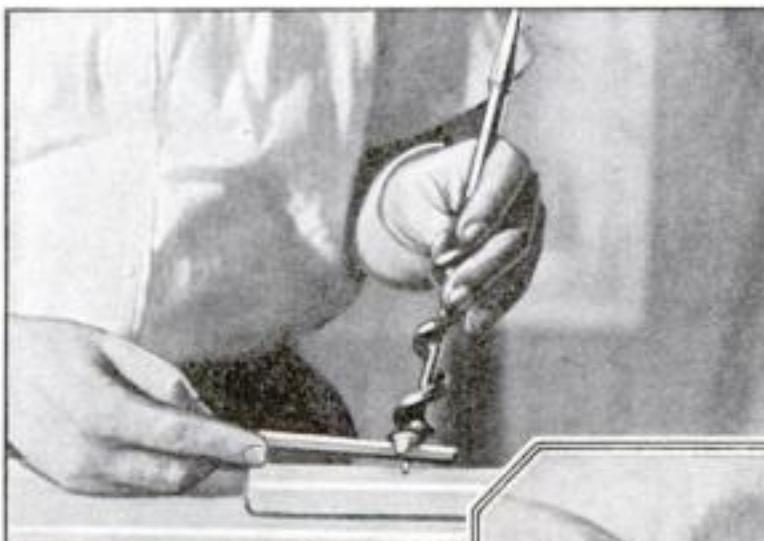


By placing the parts of the mold on a traveling conveyor, the manufacture of building-blocks is carried on continuously

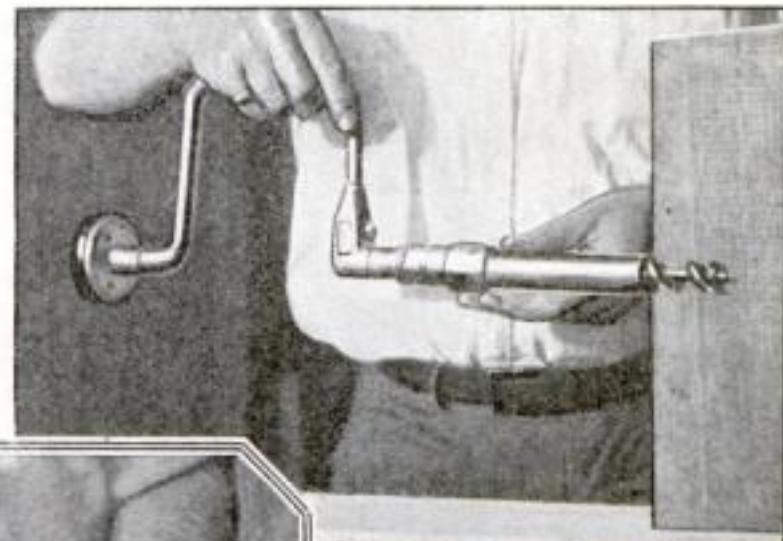
1970

How to Get the Most from Your Bit

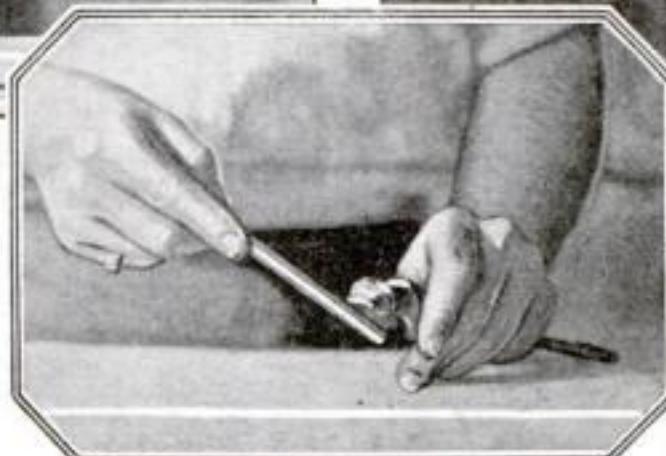
No. 2 in a series showing How to Use and Care for Tools



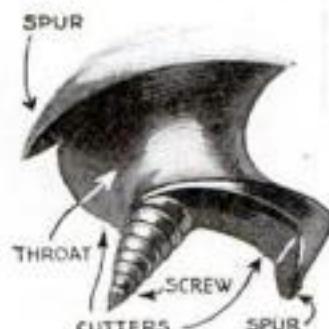
When the cutting edge becomes dulled, it can be restored by drawing a file across both cutters. Do not attempt to file the outside edge of the bit head.



The illustration above shows very clearly how the screw, the spur, and the cutter work together in cutting away the wood and lifting it out of the hole.



Sometimes, but not often, the spur—which is the sharp point that scores the wood and outlines the hole—needs sharpening. To do this, hold the bit as illustrated above and draw the file backward, filing lightly and on the inside only.



The cutter head must be kept in good condition to make the bit cut cleanly and evenly.



Screw pitch varies with the size of bit and work. A quick thread is for rough work; a slow thread for fine work.

Bicycle Steers from the Rear

1970

AN English inventor, Mr. Fenner, claims that his reversed bicycle is very easy to ride uphill and unusually light on tires, since the weight is borne equally by both wheels. The mechanism of the usual bicycle is exactly reversed. The drive is from the front wheel and the steering from the rear. The rear wheel is connected with the handle-bars by a rod attached to the crown at the head of the machine.



This bicycle steers from the rear wheel and is driven from the front.

Why Do We Do It?

Why do we run the engine with the garage door tightly closed?

EXHAUST gases from an automobile contain a large percentage of poisonous carbon monoxide—the fatal “fire damp” so dreaded by miners. When a cold engine is warmed up inside the garage, with the doors and windows tightly closed, enough of this gas is produced to constitute a serious fire risk and danger of explosion.

Breathing it for only a few minutes may cause a prolonged headache.

Carbon monoxide combines instantly with the hemoglobin of the red corpuscles of the blood to form a stable chemical compound that persists for hours, even in the open air. During that time the corpuscles are unable to absorb oxygen from the air. The effects of breathing carbon monoxide for a few minutes are the same as those that would follow the temporary loss of a pint of blood. Open the garage door when the engine is started.

WHAT DO YOU DO

—that you know you shouldn’t?

What are some of the familiar practices of every-day life that we all know are stupid and yet that we rarely try to conquer?

Send your suggestions to the Editor.

Plowing with a Street-Car

RECENTLY, when the Sioux Falls traction system had found it necessary to plow up the roadway in order to install a switch, they decided to use their own power for this work. To one of their work cars they fastened a side outrigger a ten by ten inch timber fastened to which was an extra heavy breaking plow.

The heavy chair which pulled the plow could be slid back and forth on the outrigger timbers, in order to adjust the position of the furrow. The improvised work-car plow accomplished more in three hours than could have been done in a day’s time with teams.



Outrigger and plow used by a Sioux Falls company to tear up the roadbed.

Try These Speed Indicators on Your Mental Gears

A Course in Quick Thinking, conducted by Sam Loyd



Lighting the Boulevard

After the trustees of a small township had voted an appropriation to provide for a fixed number of electric-light poles to skirt the main highway through their bailiwick, the Ways and Means Committee made a report to the effect that if the poles were set 440 yards apart, as had been suggested, they would need three more poles, whereas if they were erected three quarters of a mile apart, there would be three poles left over.

There were the usual divergences of opinion that are so familiar to all small-town meetings, and after listening to the individual view of each trustee, the chairman decided to settle the matter himself.

"Go ahead and use the poles provided for," he ordered; "have them equidistant apart and see that you use all of them."

If the chairman's orders were carried out, and the extreme poles stood on the town's boundary lines, what was the distance between poles?

\$25 in Prizes

EDUCATORS say that puzzle-solving is the best kind of mind-training—best, because it comes as sport instead of drudgery. As proof of this, consider the fact that Sam Loyd's most faithful puzzle fans have been inventors, engineers, and business men.

A first prize of \$10 will be awarded the reader who sends in the best set of correct answers and analyses covering the four problems on this page; a second prize of \$5 for the next best set; and ten other prizes of \$1 for the ten next best sets.

Answers must be received not later than January 9, addressed to the Puzzle Editor, Popular Science Monthly, 225 West 39th St., New York, N. Y.

By "best" is meant absolute correctness of solution—then, if other points must be considered, clearness of analysis. Mr. Loyd's decision must be considered as final. In case of a tie, each competitor will be awarded the full amount of the prize tied for.

Answers and names of the prize-winners will be published in the April issue.

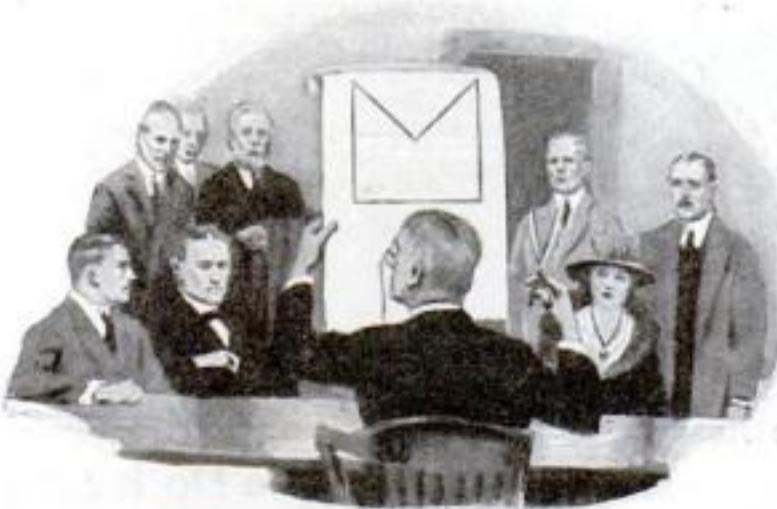


How Much Was Offered?

A REAL-ESTATE dealer was endeavoring to sell an old condemned building to a house-wrecker, of course, for the best price that he could get. The wrecker didn't think much of the condemned structure, but was willing to do business on a basis of \$1500 less than the owner's asking price.

After going over his figures several times more, the owner finally came down 25 per cent in his demand, but there still remained a difference of \$1250 between the owner's and the wrecker's figures, and the deal was declared off.

What was the wrecker's offer?



A Practical Referee Settles the Question

EIGHT wrangling heirs, who were equally interested in a certain piece of land, took a map of the property to an attorney and begged him to make an adjustment so that there should be no more wrangling.

After giving the matter due consideration, in Solomon-like manner the attorney picked up his shears, and cutting the blue-

print into eight sections, gave one to each.

"There, you each have a piece of the same shape and size. Divide your property likewise."

The miter-shaped diagram in the illustration is of the property in question. Who can duplicate the attorney's feat and mark off the figure into eight sections of similar shape and size?

When Were the Cars Nearest Together?

TWO friends who had been automobiling through the same section of the country, without being aware of each other's whereabouts, subsequently found it interesting to figure out how close they had come to meeting.

It appears that A came from the north on a highway that crossed at right angles another road, running due east and west, on which B at the same time was moving eastward. Thus their data resolved into a problem that may be presented as follows:

A and B started from north and west simultaneously, A going from north to south at the rate of 32 miles an hour; B going west to east at the rate of 24 miles an hour. From A's northern starting-point to the crossroads is 60 miles; from B's western starting-point it is 70 miles.

If they started their journeys at 12 o'clock, noon, and traveled steadily for three hours at their respective speeds, at what time were the two cars closest together?



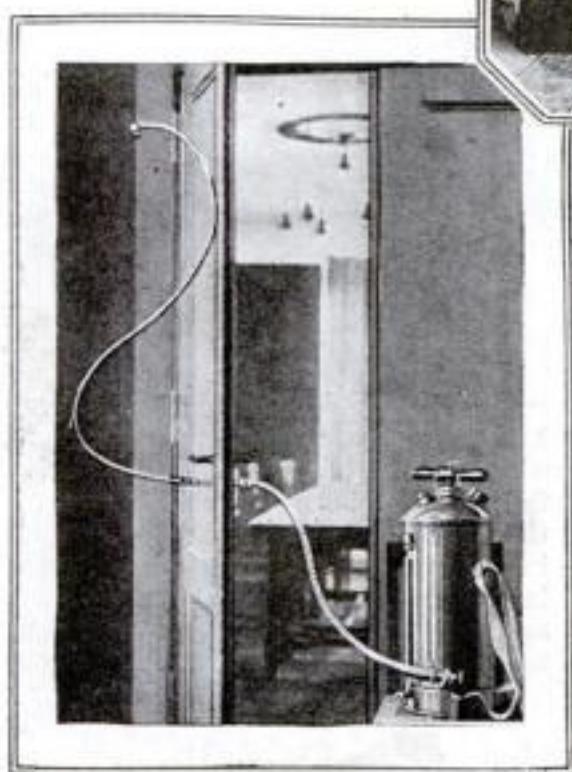
For the Comfort and Convenience of the Family



An adjustable light combined with a smoking stand will give the final touch of comfort to a wintery evening at home by your own fireside



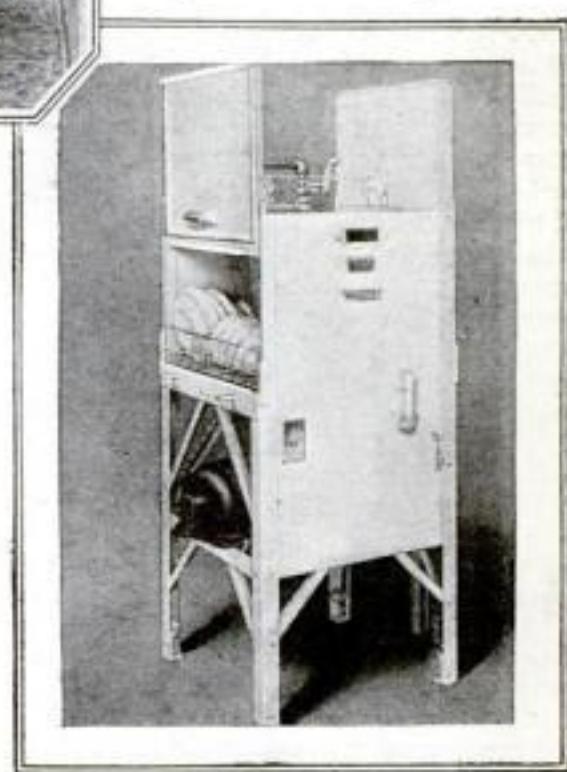
The electric wires woven into the fibers of this blanket are connected with an ordinary lamp-socket and the current keeps the patient comfortably warm



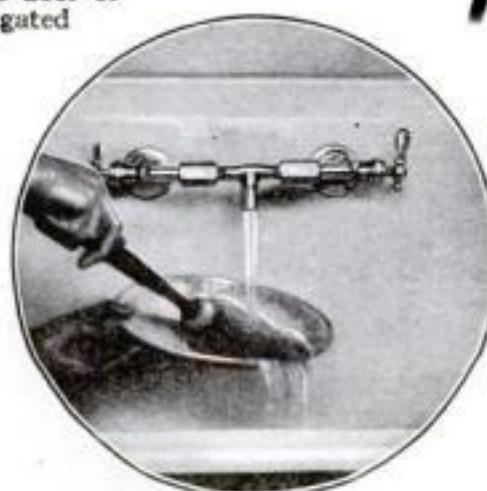
A portable fumigating outfit for the sickroom, consisting of a pump in which the disinfectant is placed and a flexible tube leading to a keyhole in the door of the room to be fumigated



The light from gas-mantles can be increased by steeping them in vinegar. It is also claimed that this makes the mantles longer



A dasher blade in the base of this dish-washer throws a cleansing stream of water over every dish and cleans a trayful in less than a minute. It is operated by a motor



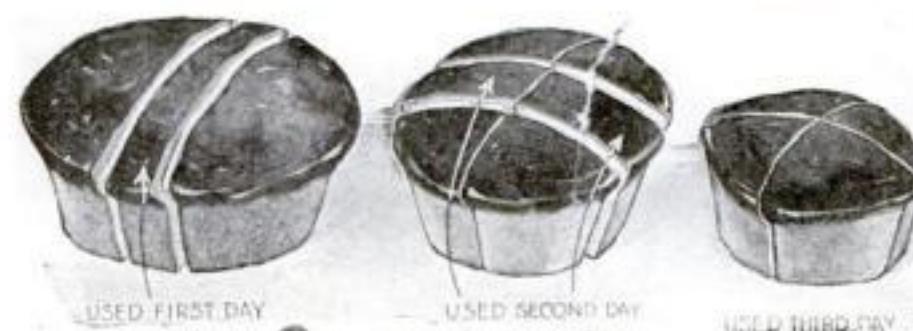
When not used for dish-washing this mixing link can be turned back so that the water will run down the sink-side without splashing everything in sight



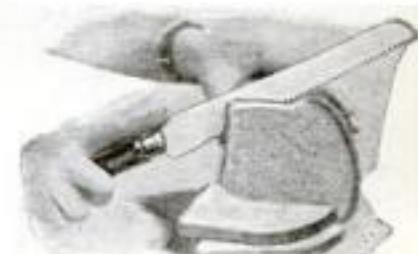
A deodorizer and night-lamp can be made by placing a small cake of gum camphor in a shallow dish of water and lighting the camphor



This attachment is for sewing heavy material. After the needle is passed into the fabric, a vise arrangement pulls it through



By cutting the cake as shown, it may be consumed down to the last crumb without becoming dried due to exposure



Teeth of different lengths, similar to those found in the woodman's cross-cut saw, make it possible to cut new cake into very thin slices

He Gave the World an Improved Battery

Newly invented process reduces weeks to seconds in forming battery plates

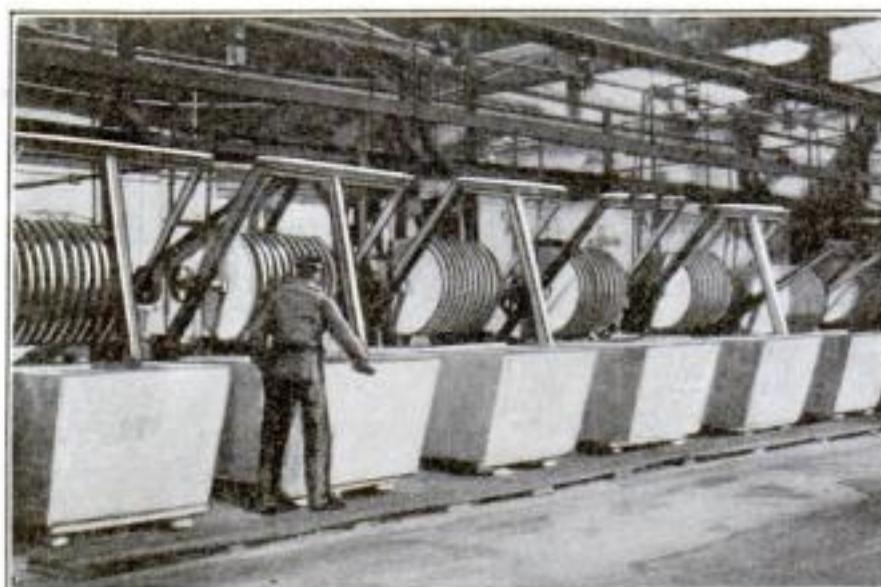
A FUNDAMENTAL improvement in battery manufacture that reduces the time required to form a lead plate from weeks to seconds has been made by Pedro G. Salom, of Philadelphia, for thirty-five years a prominent figure in the manufacture of storage batteries.

The new battery is not only cheaper in cost, but it will increase the voltage 5 per cent over that possible with "pasted" battery plates, and will enlarge the capacity more than 25 per cent. It is said to be the first basic improvement to be made for more than forty years—since 1881.

Salom forms negative plates by applying the spongy lead directly to the grid by hydraulic pressure. It is one operation, finished in a few seconds. Other processes laboriously build up a spongy lead plate by pasting litharge on the grid by hand, later converting this oxide to spongy lead by slow, laborious electrolytic processes that take weeks. The oxides must be pasted, dried, formed, cured, and developed. Under the Salom method, the material is simply applied at a pressure of fifteen hundred pounds to the square inch, and the battery is ready for use. Manufacture becomes a direct process instead of an indirect one. The improvement in operation is due to the fact that the enormous pressure exerted in squeezing the active material into the grid establishes a mass conductivity not possible to obtain by hand work.

The improved storage battery is the out-

come of an earlier discovery of Mr. Salom's, by which he improved the process of reducing lead from the ore by electrolytic methods. Under his method the lead is recovered in the spongy form, precisely as it is found on a fully charged negative storage-battery plate, and, familiar as Mr. Salom was with storage batteries, it seemed



A row of electrolytic cells in which the spongy lead for the Salom grids is produced

to him wasteful to convert this spongy lead into litharge, send it to the battery manufacturer, only to have him paste it on the grid and reconvert it into spongy lead again. His training as an electro-chemical engineer made him able to produce the active constituents of storage batteries, namely spongy lead and lead peroxide, in bulk. The difficulty was to hit on a process of applying them to the grid.

He found that if a mass of spongy lead



Pedro G. Salom, inventor of a method to reduce the process of lead-plate formation from weeks to seconds

is washed in water and then dried to the exact degree, which arrests a superficial oxidation of the lead at just the proper stage, it might be compressed on to the grid without destroying its spongy nature. If the mass is too dry, or too moist, it is pressed into a solid sheet, useless for storage-battery work. The lead peroxide is moistened and pressed on the positive plate in a similar way, a special binder being used.

As a result the plates hold more active material, and the voltage and life of the battery are increased. To demonstrate the superiority of his invention, Mr. Salom constructed a miniature plant, which he set up in the factories of the leading manufacturers of automobiles throughout the country. He made his battery plates before their eyes, put them in a standard container, and allowed the automobile engineers to run comparative tests with the best "paste plate" batteries.



Vacuum Cleaner for Automobile

THIS compact vacuum cleaner has been made unusually light and portable with a long electric cord so that it can be carried into every nook and corner of the car. A limousine is rather hard to clean, and the amount of dust that sifts through the windows in a day's travel is surprising.

In spite of its small size the vacuum cleaner will do the indoor-housecleaning as well as the larger machine. It operates on either alternating or direct current.

A Jeweler's Idea of Car-Building

WHEN a Fifth Avenue jeweler adopts automobile-body building as an avocation, the result is likely to show the effect of his professional love of fine finish and beauty of line. As the illustration shows, the jeweler has left the beaten paths of motor-car design.

He took a special sport chassis, built in 1915, with a wheelbase of 143 inches and an engine of seventy-five horsepower. He stripped off the old-fashioned body and built on the rugged frame a car that is ultra modern in every respect. For instance, the mudguards are double, in order to hide the supporting bolts, and

are heavily outlined in brass to prevent rattles and squeaks. A brass strip, so attached that no screws or nails show, runs along the entire upper edge of the body behind the cowl. A dashboard of aluminum was installed containing speedometer, altimeter, cigar-lighter, pressure-gage, ammeter, voltmeter, motometer, clock, oil indicator, lighting buttons and switch. The cutout was ingeniously placed on the steering column, while the air-pump, choker, and other instruments were placed on the side of the car within easy reach of the driver's right hand. A special spotlight, with a long handle was another novelty.



When a jeweler set his hand to automobile design, this was the result. Virtually every part is a radical departure from conventional plans.

New Steam-Car Has Engines on Rear Wheels

THE thousand-dollar steam-car is now in process of production. It is an attractive, five-passenger machine of conservative design. The boiler is placed under the hood, with the engine located in the rear axle, where it takes the place of the usual differential mechanism. Three cylinders drive each rear wheel direct without intermediate gears. Each three cylinders are disposed at 120 degrees and their pistons are connected with a common crank-throw, which is merely an extension of the axle-shaft that runs to the wheel. Inasmuch as each wheel has its own engine, no differential mechanism is required. In fact, there are no gears at all in the rear axle.

Exhaust steam is delivered to the radiator, which acts as a condenser. Transmission of steam to and from the rear axle is through two pipes, the top one connecting boiler and engine and the bottom one the engine and radiator. The lower pipe also acts as a torque tube, relieving the car-springs of driving and torque strains. The forward end of this pipe terminates in a ball joint.

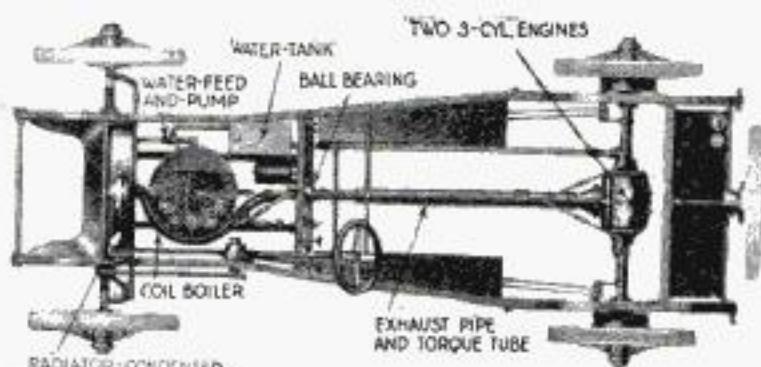
The exhaust steam from the engine is condensed in the radiator and flows to a small water-tank, from whence a pump forces it into the boiler. The boiler is a water-tube operating at six hundred pounds pressure and the fuel used is kerosene.

This new steam-car, in common with all recent designs, employs the principle of intermittent boiler opera-

A broken-away view of the steam-car and its boiler and driving mechanism. The steam generated under the hood is carried by long pipes to the engines on the rear axles



tion. In years gone by, steam-cars, like locomotives and stationary power plants, operated on a constant boiler pressure, and the feeding of fuel, air, and water was varied to keep constant pressure. In order to make this work automatic, the machine was loaded with complicated devices that had much to do with the decadence of the steam principle in past years.



The chassis of the low-priced steam-car. Its steaming action is automatic and is regulated by an electric motor fed from the lighting system. There are no gears in the car, the position of the engines eliminating all need for differentials

The modern idea is to operate the boiler intermittently. For example, when the pressure reaches six hundred pounds, fuel, air, and water pumps stop working, and the fire under the boiler goes out. When the pressure drops to, say, five hundred and fifty pounds, perhaps a minute later all three pumps start again, a spark-plug lights the fire and the boiler runs full blast until the pressure rises again to six hundred pounds.

It is easy to see that the operation of this system is simplicity itself. Fuel, water, and air pumps are driven by a single electric motor. When the pressure drops to five hundred and fifty pounds, the circuit is closed; and when it reaches six hundred pounds it is automatically opened.

Current for the electric motor that keeps everything going is supplied from the regular lighting circuit. The generator that supplies the storage battery is located under the floor boards and is driven by a long shaft from the rear axle.

Fan-Belt Drives Tire-Pump

SOMETHING new in automobile accessories is a rotary power-driven tire-pump that occupies less room in the toolbox than the ordinary hand pump.

The pump consists of a wheel that is rotated against the fan-belt and which is the cylinder of the pump. The rotation of the cylinder actuates an eccentric that operates through a hole in the cylinder and delivers the power to the piston of large diameter and short stroke. This takes in the air through a shaft containing a port, which opens and closes for the admission of air. The air is compressed and forced through a mohair-covered tube attached to the tire-valve. The handle provides means for attachment to the car through a bracket that is bolted behind the fan-belt. The spring from the bracket to the

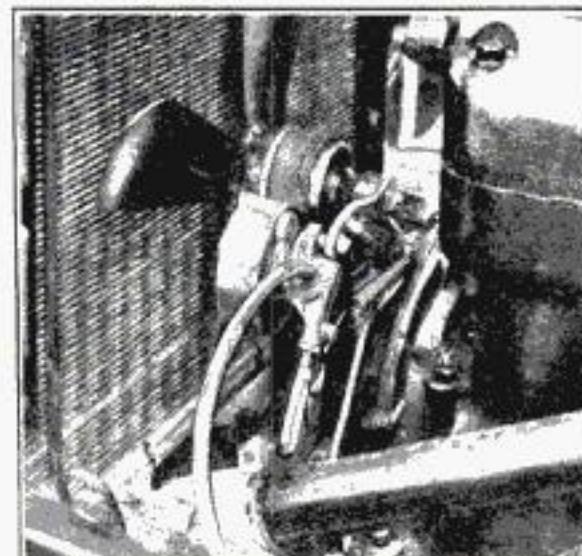
The entire device weighs less than four pounds.

Keep Axle Grease off the Brakes

THE grease in the axles of Ford and Chevrolet cars will often work out through the axle housing on to the brakes. If this should happen through wear of the axle parts, the trouble may be eliminated by a new device made especially for the two makes of cars mentioned. The device consists of a single steel spiral spring that fits closely to the axle-shaft.

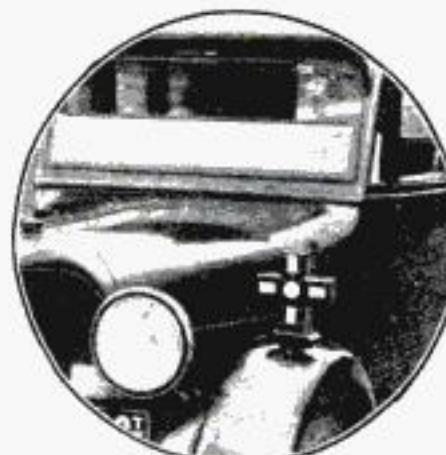
It revolves with the live axle-shaft and works the escaping grease back toward the differential housing.

To install them it is necessary only to slip the springs over the axle-shaft and replace the bearings and wheels.



The pulley of this rotary pump driven from the fan-belt is also the pump cylinder

Odd Safety Signal on Fender



With all four arms and the center lighted, this signal warns other drivers that the car is to be turned around. There are nine combinations to indicate the intentions of the driver.

Placed on the left fender, the signal is visible to the cars ahead and to those behind.

A special code that in its various combinations informs other drivers of the next movement of the car, has been devised.

WHEN the Underwriters' Laboratories receive an automobile bumper for testing, it is mounted on a stripped chassis frame bolted to a concrete floor. A short length of 24-inch pipe filled with concrete and weighing about six hundred and fifty pounds is suspended by a 62-foot cable immediately in front of the bumper, pulled back twenty-four feet, and released.

The impact of the weight equals that of an automobile weighing two tons traveling four miles an hour, and the shape of the pipe simulates collision with a telegraph-pole. The effectiveness of a bumper depends on the security of its fastening. The tests seldom break the bumper itself.

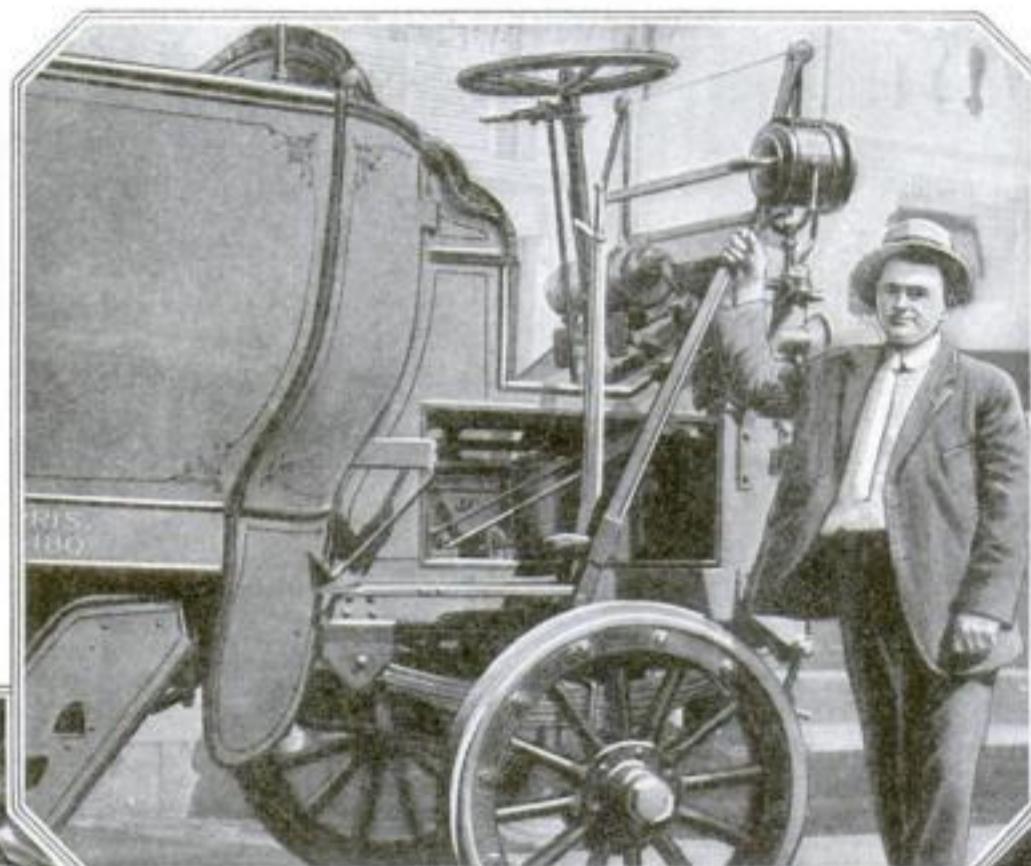


Whether the temperature be above or below zero, this gage gives the correct gravity of the gasoline being sold to you by the pumping station. It is a combination of thermometer and hydrometer

AS a Special Service to Readers the Editor will be glad to furnish the names of firms manufacturing the interesting devices and accessories for motor-cars illustrated on these pages.



Three feelers extending from the vertical rod detect the slightest unevenness in cylinder walls and transmit the degree of eccentricity to the dial. All measurements between two and one half and six and one half inches may be made



A connection between bus door and gear-shift makes it certain that the bus cannot be started until the door has been securely closed. The same lever also slides the steps into and out of position



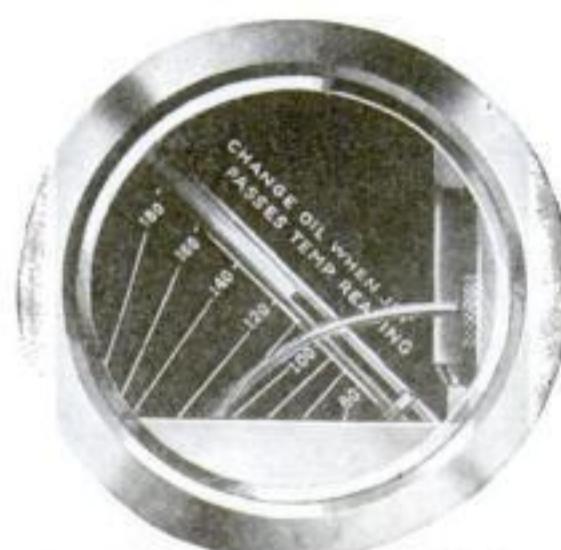
A long leverage on the tire-lifter eliminates heavy lifting and makes tire-changing easier for the woman driver, besides doing away with the possibility of soiling the clothes



Sometimes the spacing of the points in a spark plug is wrong. This tester makes it possible to watch the plug in actual operation. Plate-glass covers the aperture



This tire-spreader is different from many others in the fact that ten metal fingers open the tire at points entirely around its circumference



When the oil in the engine needs renewing, it is shown by the jet of oil that rises in its arc and passes the mercury in the thermometer



The tire moves around the inspection machine on rollers while a pressure in the foot lever spreads the beads of the tire wide open and expedites inspection

When You Want Expert Advice About Your Car

IN these six pages of ideas about automobiles and motor-trucks Popular Science Monthly endeavors to help its readers solve problems of maintenance and repair. But there must be special cases that are not cov-

ered, and we invite you to write to the Automobile Editor and let him advise you.

If you wish to know more about the devices pictured here, or if you want to ask questions, write. See a few typical answers on page 81.



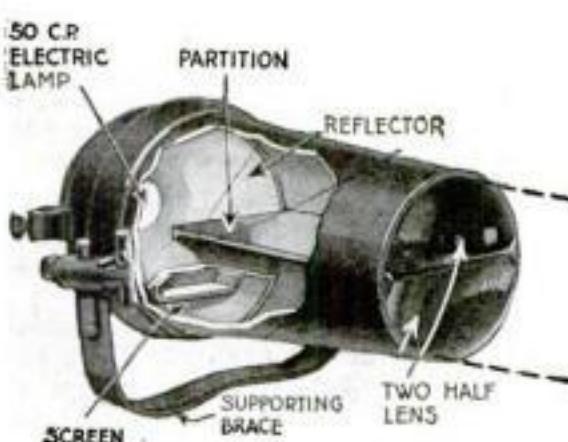
The petty thief is frustrated if the thermometer and radiator cap are secured by means of the anchorlike protective device pictured above.



By virtue of its hinged, split-frame construction, the front and rear wheels of this new tractor can be tilted at opposite angles, as pictured. The machine has the same speed and power whether going backward or forward.

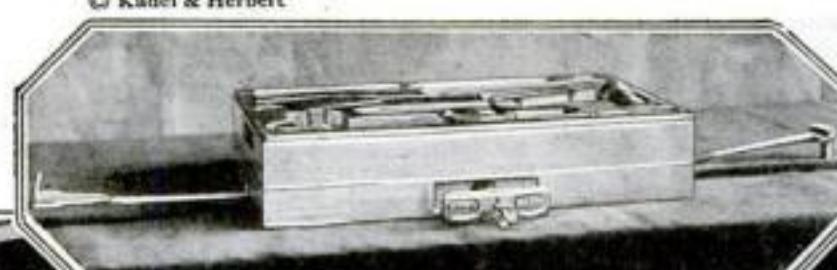


This new utility wrench, with its four hexagonal openings besides the large one in the center, can be used with every size of rim lug.



The new English anti-glare attachment pictured above in cut-away view can be fixed to any headlight of conventional type. The split-lens construction eliminates all rays more than shoulder high.

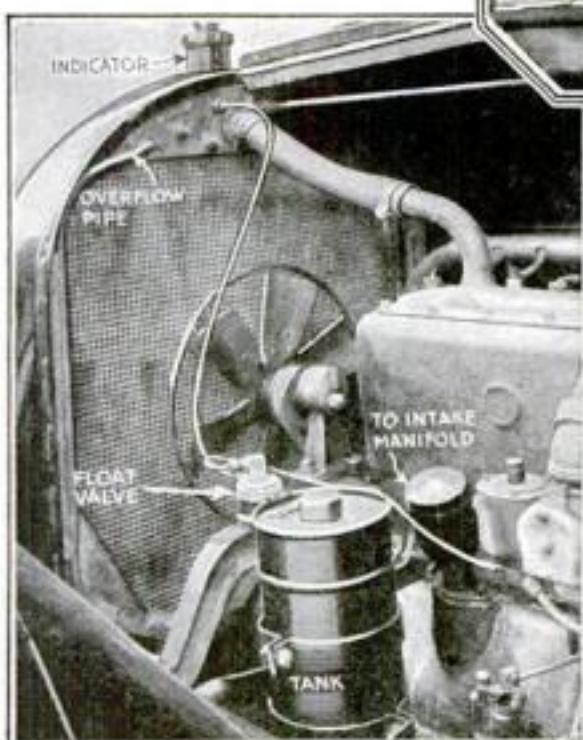
© Kadel & Herbert



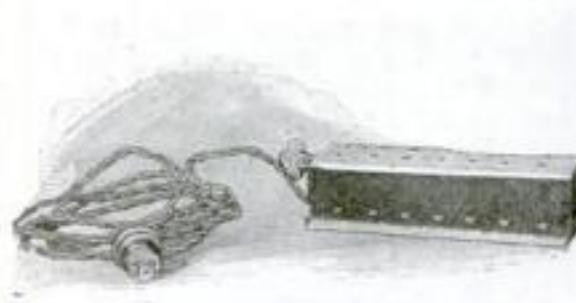
A new running-board tool-chest for motorists consists of three trays, each with depressions into which the appropriate tools fit snugly. Piled one on top of the other, the trays are locked together by means of the steel band shown.



Steering column headlights of the above type can be tilted forward by a small lever when it is desired to protect the driver of an oncoming car from their blinding rays.



This equipment, built on the vacuum-feed principle, keeps the automobile radiator filled by condensing and returning escaping steam. When leaks develop, a warning whistle blows.



The radiator will never freeze up overnight if the garage is equipped with this heater. The motorist simply places it on the engine and turns the switch.



With this compressed-air apparatus the garageman can dispense measured quantities of heavy lubricant direct from the original container. The hose connects to crankcase, differential, etc.

Why I Believe You Should Buy a New Car

It looks better, gives greater riding comfort, and has more labor-saving accessories than the used car

By S. P. McMinn

IF I were to buy another car now, I should buy a new one, just as I bought a new one the last time, and the time before. I get far more satisfaction out of a new car than I could possibly get out of the amount of money I might save by buying an older one.

But my real reason for purchasing a new car would be a utilitarian one. I use my car in my business quite as much as I drive it for pleasure. Hence, I cannot be annoyed with the petty troubles that invariably complicate life for the average used-car driver. From a business point of view these annoyances represent time lost; and when I drive for recreation, delays to fix one thing and adjust another are a nuisance, and often an expense as well.

But my new car runs like the proverbial top from the time I step on the starter until I shut her off in the garage. I'm not worried with ignition wiring dropping off, with a gripping or slipping clutch, with faulty brakes or a grind in the rear end—all the results of some one else's careless or ignorant driving. I don't have to be eternally tightening nuts and bolts, or, as more generally is the case, chipping them off with a cold chisel and a hammer because the former owner never touched them and they have rusted solid. Of course some few minor adjustments are likely to be necessary after the first few hundred miles of driving. That's to be expected. But they are adjustments that are easily made by any one. And if the owner cannot make them or does not care to, he has always the manufacturer's service station to fall back on.

For remember, the new car is guaranteed by the maker for ninety days under a guarantee that the dealer causes to include anything that may prevent that car from giving perfect service. This takes in all those minor but necessary adjustments. The dealer is not only willing to give the service, but is anxious to do so, for his best adver-

NEVER before to our knowledge have the respective merits of the New and Used Car been exhaustively argued in print. Last month Popular Science Monthly published a motor expert's plea for the Used Car. On this page the other side of the argument is now presented. Winter is the time to buy used cars. The spring automobile shows will soon be here with their galaxies of new cars. These articles will help you form an intelligent opinion as to which type of car to buy.



Tests show that in a used car imperfect combustion permits condensed gas to leak into the crankcase, diluting the oil

tising is word-of-mouth advertising—satisfied-customer advertising.

Thus, I place Freedom from Trouble high on the list of reasons why I will buy a new car next time. Freedom from trouble also means safety. I do not know, and have no means of knowing, in buying a used car, what parts may have been strained to the point where they are likely to let go and put my life and the lives of my passengers in danger.

And tires. Tires are among the most deceptive things about a car, particularly to the average person, who knows little or nothing about them. Often enough they fool the expert. They look all right, good for thousands of miles—generally, because the person who is selling the car has "dolled" them up to look that way. But it is the inside of the tire that tells the story, and you can't see the inside. Even if you could, you would have to take the car or leave it—with the tires it had on it.

So you'd buy new tires—not right away, perhaps, but before you had driven it very far. Even if it is a very small car, four tires, not counting the spare, will cost in the neighborhood of \$80. If you buy good cord tires, which, by the way, are a real investment, then they will set



Easy riding depends on spring design and suspension. The comparative resiliency of springs in new and used cars can be easily demonstrated as shown above

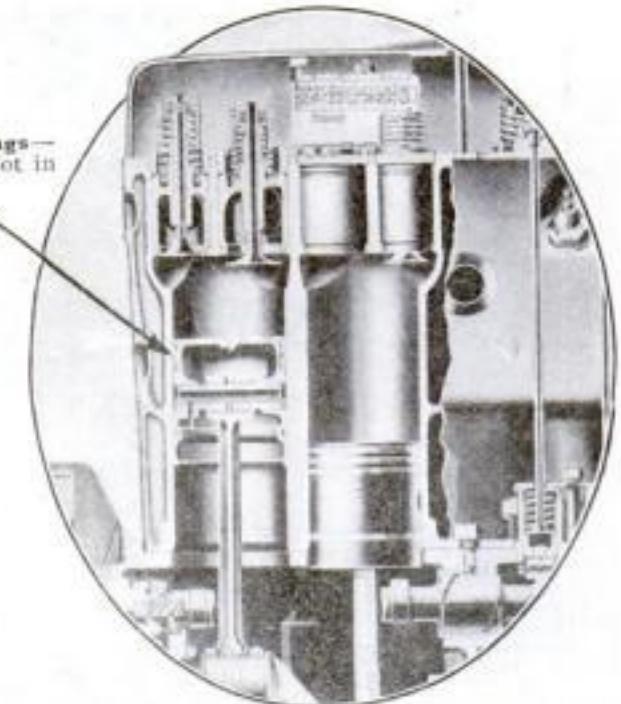
you back about \$120. Now add that to the original cost of your used car.

But with my new car I have no tire trouble for thousands of miles. Punctures don't annoy me because the tires are so new that ordinary tacks and nails don't penetrate them. Blow-outs are unknown. I roll along for 8000, 10,000 miles—I got better than 11,000 out of the tires on my present car—and literally don't know there is rubber under me.

Another important reason why I shall buy a new car is because it is modern. Improvements are constantly being made in automobiles. They are not made for the mere pleasure of making them. They are necessary improvements. They are improvements that have to do with economy, flexibility, smooth-running and safety.

On the score of economy alone a modern car is miles ahead of a car that is even so little as a year old. Our gasoline is getting worse every day. It's about all an old car can do to run on it at all. But my new car is designed from the ground up to use just exactly the grade of fuel I get everywhere all over the countryside. It is designed to use some of the heat of the burning fuel in order to make the rest of it burn economically—that is with the utmost efficiency.

Then, too, unless the fuel is completely burned, it condenses and gets down past the piston-rings into the crankcase, where it dilutes the oil. The result is that this oil is used up far more rapidly than it should be, which means a big oil-bill. An even worse result is that the bearings and pistons are improperly lubricated. This in turn means sloppy pistons, worn rings, and perhaps scored cylinders. It may also mean burned-out connecting-rod or main bearings. That's one reason why all the oil companies advocate heavy oil for old cars. They simply allow for the dilution they know is occurring. Also, an important point to bear



New cars have no scored pistons and worn piston-rings. Because of this, they run more silently, with lower fuel cost and greater reserve power

in mind is that the heavy oil quiets an otherwise worn and noisy motor.

Then there is the ease of control. As I said before, I drive my car in my business and also for pleasure. As a business car it must not be unduly fatiguing to drive. And pleasure driving must be pleasure, not work. Old cars steer hard, due to faulty construction, to wear in the steering parts, or to lack of lubrication.

Better design in my new car has brought about a proper proportioning of the linkage and leverage and therefore it steers easily and requires little lubrication. What lubrication it needs is taken care of by a little jigger of a grease-cup to which I fit a big grease-gun, and force the lubricant where it ought to go—force out the old, tired grease, and force in the new. Incidentally, every other part of my new car is lubricated in the same way.

A two-hour, mussy, dirty job on an old-style car becomes a nice, clean, fifteen-minute job on my new one. And everything is lubricated properly.

Clutch-springs are heavy in old cars, and so are the springs that hold the brakes off. This means leg strain. It means a tendency to "ride" the clutch, and this wears out the clutch collar bearings in short order. On my new car, on the other hand, I can release the clutch with one finger and bring the car to a stop with the lightest imaginable touch of the service brake. The answer is summed up in better, more modern design coupled with better lubricating methods. They mean easy control. They make it fun to drive.

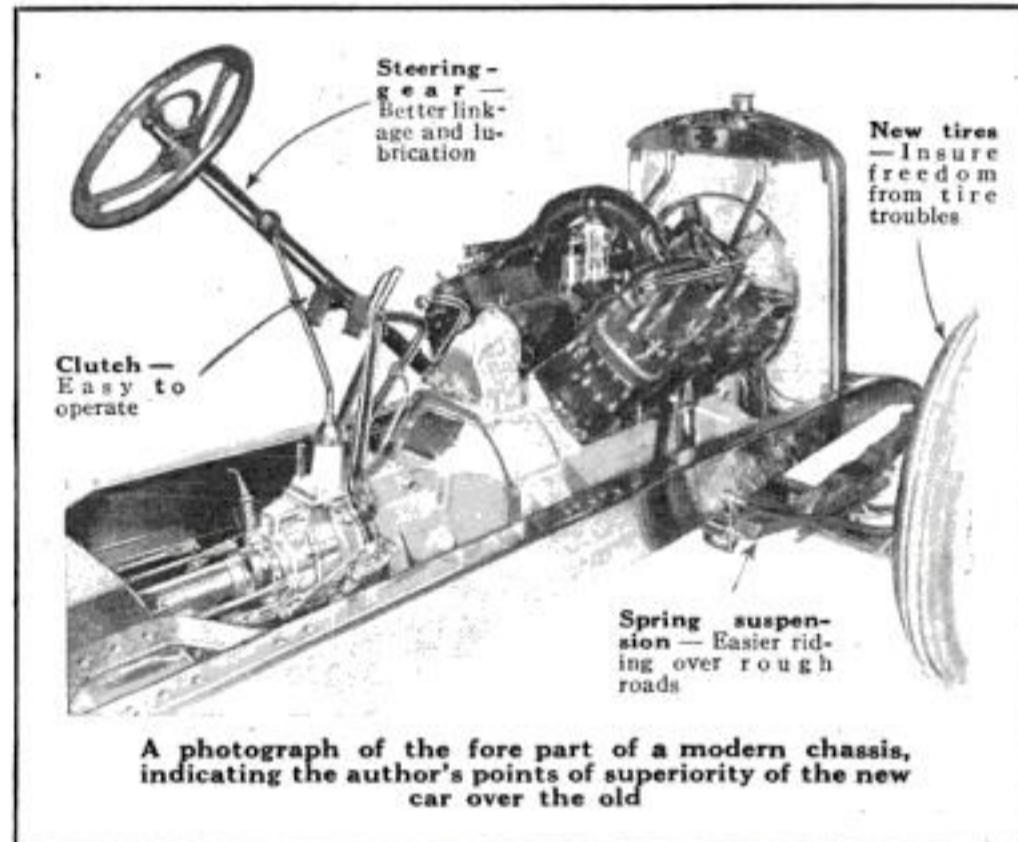
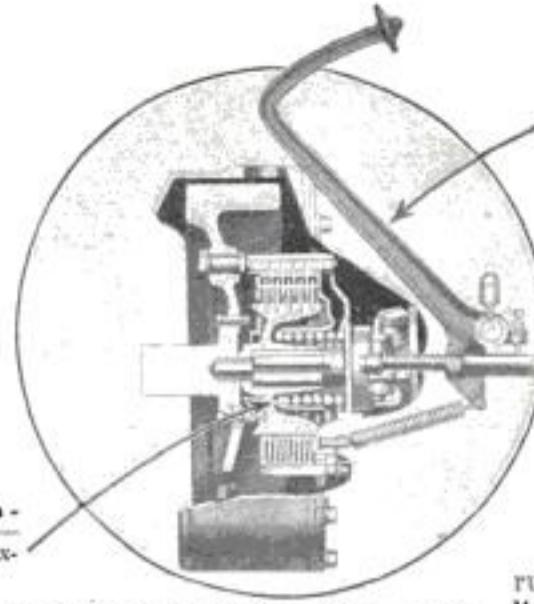
And now look at the

equipment I get with my new car.

There are side curtains that open with the doors and really fit properly—not jammed under the rear seat, wrinkled and torn and with half the celluloid gone. They are put on in a second and taken off as quietly. They are not a Chinese puzzle even to my wife. My new top is a one-man top, put up easily in a minute or

Clutch-springs
more flexible

Better-proportioned linkage, lever- and clutch-springs make it possible to operate a modern clutch with less effort



A photograph of the fore part of a modern chassis, indicating the author's points of superiority of the new car over the old

two and folding compactly out of the way when I don't want it. My speedometer is geared to the gearset and so I don't have any trouble with fiber gears chewing up through their inability to chew up the road gravel they feed on. Nor does my speedometer cable freeze in winter and break, or run foul of a tire. My lights are modern and efficient. My demountable rims fit properly.

On the score of materials that go to make up my new car I know that the maker has used vanadium and molybdenum steel so the parts may be made smaller and lighter, easier on tires and a miser for gasoline and oil.

For roadability and rideability my new car is far better than a used car. And my new car is a better investment than a used car, as witness my own experience. I bought a new car that cost me \$1040, delivered. It came to me brand new, shiny, beautiful. It ran perfectly. I drove it for a little over a year, covering approximately 11,000 miles, and sold it for \$850 cash. In that year I never had it near a service station, never stopped on the road for trouble of any kind, and never spent a penny for repairs.

Write to Us About Your Motor Troubles

If you have a motor-truck or automobile problem, let the Automobile Editor solve it

Advice to New Driver

Q.—I have just taken delivery on my first car. What advice can you give me regarding driving or care of it?—G. A. M., Tallahassee, Florida.

A.—As to driving, be twice as careful under all circumstances as you think that you ought to be. Keep your eyes open and use your imagination. Thus you should be able to foresee almost any road crisis.

Treat your car with as much sympathy as you would a thoroughbred horse. Never abuse it or neglect it. Above all, do not neglect its lubrication. If you give it plenty of oil and grease, it will last indefinitely. Inspect it once a month for loose nuts, worn insulation, etc.

Never take anything for granted—a little scrap of advice as important as it is difficult to keep in mind.

Horsepower Formula

Q.—Can you give me an accurate horsepower formula?—D. D. B., Fargo, S. D.

A.—There are so many variable factors in an automobile engine that no simple formula can be more than

approximate. On the average the following will give fairly good results:

$$\text{Horsepower} = \frac{D^2 N S R}{15,000}$$

where D is the bore in inches, N the number of cylinders, S the stroke in inches, and R the revolutions a minute.

When Building a Garage

Q.—What dimensions would you advise for building a private garage to house a single car?—M. B. M., Peoria, Ill.

A.—In building a private garage it frequently happens that the structure is cramped and poorly lighted. Good light and sufficient space around the car to permit of easy movement are essential. A margin of at least 3 feet should be allowed both at the sides and the rear. The size of the average car is approximately 6 by 15 feet, so that the dimensions of the building should be 12 by 21 feet.

If the car is a Ford, the building may be reduced to 12 by 17 feet. A large car, such as a 66-horsepower car, should have a building 12 by 24 feet. There should be several windows.

Blowouts at High Speed

Q.—Why is a blowout dangerous at high speed?—M. D. McL., Oakland, Calif.

A.—A blowout in a front wheel is dangerous unless the steering-wheel is firmly grasped with both hands; this statement applies to all speeds in excess of about thirty miles an hour. A blowout in either front or rear wheel is dangerous on a turn which is being taken at a fast rate, because it greatly increases the car's tendency to skid, and in many cases this increase is enough to cause an accident. If a car is running fifty miles an hour, and a blowout occurs in the right front wheel, the steering-wheel will be wrenching to the right and the car will swerve sharply in that direction unless the driver is prepared for just such an emergency. The explanation is that no steering-gear is fully "irreversible," and the extra resistance caused by the flat tire rolling along the road, swings the front wheels in that direction.

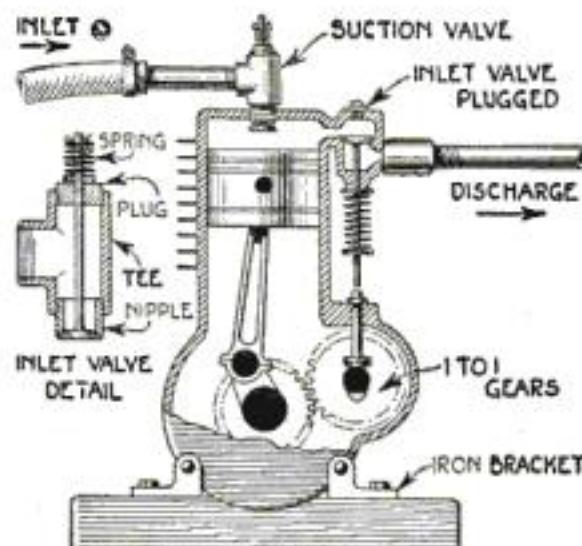
Most of the accidents blamed on defective steering-gears are caused by unexpected front-wheel blowouts.

Build a Homemade Water-Pump

By W. A. Logan

FROM an old motorcycle engine a suction water-pump may be built that will prove of great usefulness for many purposes. The timing gears of the engine should be made equal instead of leaving them at 2 to 1. This change allows the discharge valve, which was formerly the exhaust valve of the motorcycle engine, to open at every up stroke of the piston.

The inlet or suction valve is made of standard pipe-fittings and is screwed into the spark-plug hole. This valve may easily be made at any plumbing-shop from standard $\frac{1}{2}$ -in. T, with an old valve-stem ground down to fit. The stem should run through a hole drilled in the plug that is screwed in the



An old motorcycle engine may be restored to usefulness as a water-pump as here illustrated

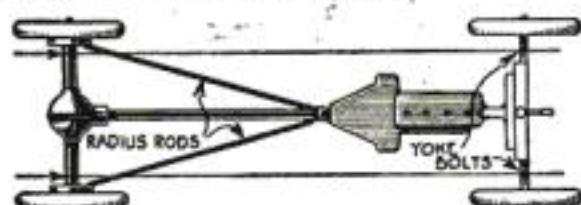
top of the T. The end of the stem is fitted with a spiral spring and cotter-pin. The spring should be of light tension, so that it allows the valve to open automatically as the piston descends, but closing it when the reverse stroke begins. At the same time the discharge valve opens and through it the water drawn in the cylinder is forced out.

It will be found that about 55 revolutions a minute is the best speed, giving approximately one impulse a second. The speed is calculated from the number of revolutions of the power pulley, its diameter, and the diameter of the pump pulley. The end of the suction hose should be provided with a screen to keep out the dirt that would interfere with valve action.

Adjust Radius or Torque Rods to Prevent Skidding

WHEN an automobile skids with the least cause and sometimes apparently without cause, the radius rods or torque tubes which hold the rear axle perpendicular to the center of the car are the reason. A bend or incorrect adjustment of one of these rods throws the center of the axle around and the wheels do not track, but tend to roll in an independent course. The rear end is naturally inclined to follow the wheels and skidding is the result.

This is one of the seldom suspected causes of skidding and the remedy is to take accurate measurements from the yoke-bolts at each side of the front axle to the rear axle and adjust or straighten the rods as required until the measurements are exactly alike.—G. A. LUERS



Incorrect adjustment of the torque rods will cause skidding and should be remedied

Device for Spreading the Springs of Automobiles

THE main portion of the device shown in the illustration is formed by a 14-in. monkey-wrench, the handle of which had been cut off with a hacksaw $6\frac{1}{2}$ in. from the jaw.

Near the end from which the handle was cut, and at a right angle to its longitudinal axis, a rectangular groove is cut, 1 in. wide and half the thickness of the steel. A piece of steel, $\frac{3}{4}$ in. thick, 1 in. wide, and $1\frac{1}{8}$ in. long, is similarly cut at one end so as to fit in the groove near the end of the wrench-bar.

The two parts are then drilled and threaded for two machine-screws that hold them together. The free end of the set-in

Were You a Gipsy-Motorist This Summer?

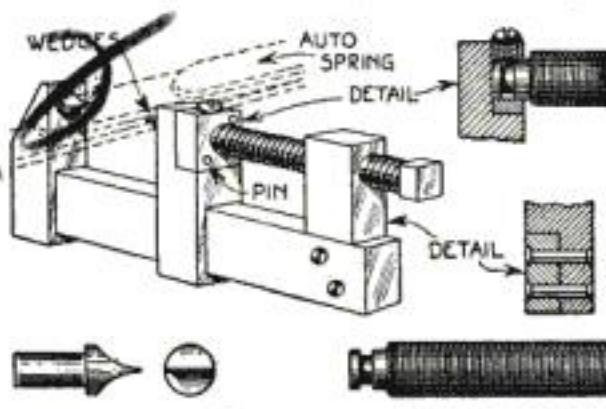
DID you answer the call of the open road this year? Did the running-boards of the "old bus" groan beneath their loads of tenting, bedding, eatables, and utensils?

Tell us how much your trip cost, where and by what route you went, what big lessons you learned that will help others make plans for a similar vacation next year, and, finally, what automobile, camping equipment you purchased or improvised.

For the most interesting and informative letter, \$35 will be paid; for the second best, \$15. Letters must not be more than 500 words long, and must be received on or before January 10, 1922.

piece of steel is drilled and threaded for a $\frac{5}{8}$ -in. set-screw.

The set-screw has a square end fitting a



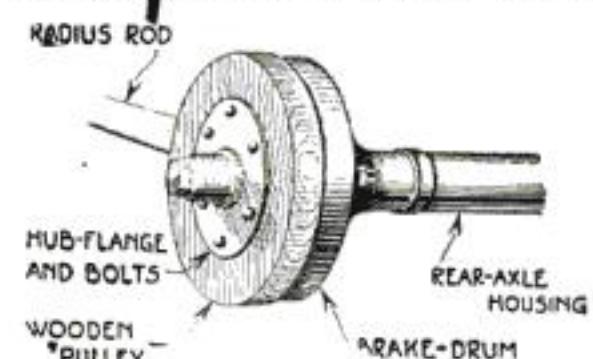
With this device the leaves of automobile springs are easily oiled

key or wrench at one end, while the other end is turned down in the lathe and provided with a groove into which a round-headed machine-screw fits. The sliding jaw of the wrench is cut off square and cut out to receive a small block of steel, drilled to receive the blind end of the set-screw.

Two rivets hold the block and the jaw together and the round-headed machine-screw already mentioned fits into the groove of the set-screw. The two pieces that wedge the springs apart are made of $\frac{1}{2}$ -in. round drill-rod. The points are ground or filed to the shape indicated in the picture and then tempered.

Let Your Ford Help in the Farm Work

ON the small farm the possession of a Ford is a valuable asset. Its sturdy engine may be employed to furnish the power required for driving or operating a variety of farm machinery, from a simple hoist to a sawmill or feed-cutter. It is an



Attach a pulley to the rear axle of your Ford and it will run your farm machinery

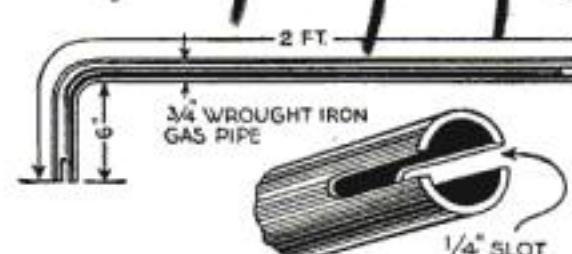
extremely easy matter to harness the Ford engine to almost any mechanical task by providing for it a pulley as shown in the illustration.

Remove one of the jacked-up drive-wheels of the car and put in its place a pulley made of an old rear hub, a brake-drum and a circular wooden disk, 2 in. thick and of the same diameter as the brake-drum, all securely bolted together as shown in the picture.—E. A. MESSLER.

Special Tool for Wing-Nuts and Petcocks

THIS tool for use in the garage while adjusting and oiling the car can be made of a 2-ft. length of gaspipe bent at one end and slotted with a saw at both ends, as is shown in the attached sketch.

This tool obviates the practice of reaching or crawling under the car to turn up

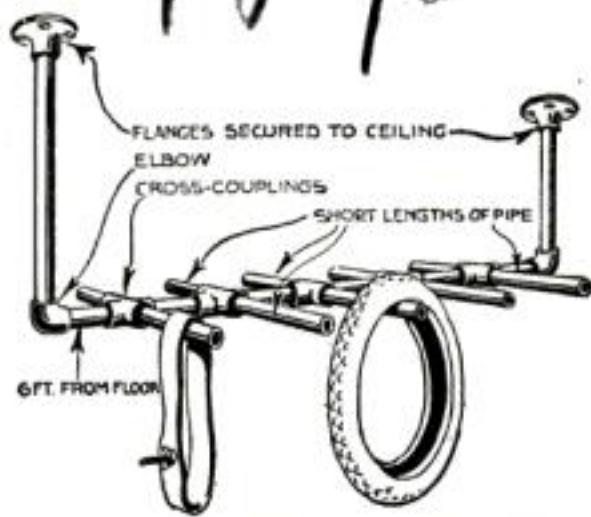


This tool will be found helpful for turning wing-nuts and petcocks

winged nuts provided for adjusting brake-bands or turning off stopcocks for the gasoline line or crankcase of the motor or the drain under the radiator or pump. The turning tool is also of advantage in turning up grease-cups of the type with a winged cup for the grease. This tool is readily made up in a few minutes and its use avoids soiled cuffs, coat sleeves, and clothing.

Shop Tire-Rack for Tubes and Casings

A RACK to hold tubes in the tire repair shop is made as shown in the illustration from sections of light gas pipe and connectors. This rack, compared with racks constructed of wood, is the same price, but is far more convenient for holding



This hanging rack offers many advantages in the repair-shop in which space is limited

a tire or tube and in locating the desired tire or tube when called for.

The rack is suspended by means of flanges from the ceiling and elbows and cross couplings are used to screw the several sections of gaspipe together. This rack is hung about 6 ft. above the floor and consequently does not interfere overhead. It will hold a large number of tires and is practically indestructible.

Auxiliary Wind-Shield for the Automobile

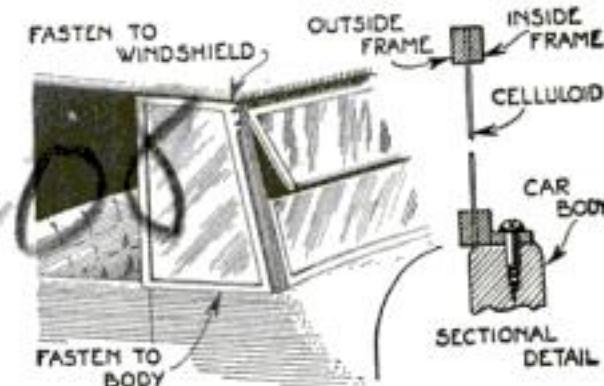
ONE form of auxiliary wind-shield which will protect the occupants of an automobile from rain and wind is made as shown in the illustration.

This shield consists of a sheet of celluloid in a brass frame screwed jointly to the edge of the body adjacent to the wind-shield and to the wind-shield frame.

One of these shields is used at the side of the car and the side curtains are altered by extending the edges so as to fasten to the brass frames. With these a clearer vision

is afforded the driver when the side curtains are in place. The transparent celluloid will not break and shatter as would glass, and when dulled it is renewable by separating the screwed brass strips. These shields are about 12 in. wide and made to correspond in height with the wind-shield.

The polished brass enhances the appearance of the car, apart from serving as a frame for the celluloid. The freedom from the usual dust and dirt obviates the use of glass or goggles.



Riding in an automobile is made much more pleasant by an auxiliary shield against rain or snow

Keep Your Home Shipshape

Interesting things to do around the house to save time, temper, and money

Fire-Extinguishers for Use in the Home

SOME means of putting out fire should be kept in every room. The following formula will provide, for a trifling cost, material for twelve or more hand-grenades that will instantly put out fire.

Get 5 lbs. common salt and 2½ lbs. sal ammoniac. Dissolve in 1½ gal. water. Bottle this up in the thinnest bottles you can find, cork very tightly, and place them where every one will be able to find them quickly, but not in too hot a place.

Should fire break out, knock the neck of the bottle off and sprinkle the contents over the fire, or throw the whole bottle into the fire against something hard with sufficient force to break it, and the fire will be extinguished.—E. A. McCANN.

Softening Sponges without Injuring Them

FINE grades of sponges, sold under the name of "baby-sponges" or "surgical sponges," are invariably freed from grit and bleached with permanganate of potassium and sulphurous acid before they are placed in the market. It has been found that this bleaching process greatly diminishes the resiliency of the sponge fibers, making them soggy and difficult to clean.

It is therefore, obvious that the unbleached sponges are preferable and more enduring, but they must be freed from the gritty particles which they contain before they can be used on the soft skin of the baby. These particles, which consist principally of carbonate of lime, may be removed without injuring the elasticity of the

sponge by immersing it for two or three hours in water containing about five per cent of hydrochloric acid. After the sponge has been removed from this solution it should be thoroughly washed in several changes of running water to eliminate every trace of the acid.

Simple First Aid for the Alarm-Clock

WHEN the old alarm-clock lies down on the job and insists upon taking a rest in spite of your shaking and twirling, the trouble is generally that the cold has gummed the oil and put the brakes on some of the more delicately adjusted moving parts.

The cure is easy. Put the clock on the stove or on the steam radiator. Let it heat through thoroughly—of course not enough to melt the solder in the case or scorch the face—and the gummed oil will soften and run out of the bearings, leaving just enough to keep everything in the old stand-by working smoothly.—F. M. WESTON, JR.

How to Make a Cracked Bottle Watertight

FREQUENTLY we have a cracked cut-glass or other bottle of good quality which we should like to continue using. To mend it and make it watertight, heat the bottle, cork it tightly, then paint the outside of the crack with sodium silicate or waterglass.

As the bottle gets cold the solution will be drawn into the crack and will make a fine, tight joint.

Putty Substitutes for Use in the House

GLAZIER'S putty is made from whiting and linseed oil. A good substitute may be made of flour and oil mixed to the proper consistency. If you have no linseed oil, some varnish or paint will do. In fact, paint is better, if of the right color.

A substitute that is better than putty when large holes or cracks have to be filled is paper well macerated in water and mixed with some flour and boiled. This, when dry, will be found to set almost as hard as iron.

Plugging Up the Nicks in Old Furniture

TO fill up the nick in that mahogany table, prepare a mixture of 8 parts beeswax, 2 parts yellow ochre, 2 parts whiting and 2 parts Indian red.

For more serious cracks, a mixture of shellac, beeswax, and resin in various colors may be bought, or the handy man may compound the mixture by melting in a tin or iron pot a cupful of common shellac, a spoonful of powdered resin and a piece of beeswax the size of half a walnut. For golden oak, add a teaspoonful of yellow ochre; for mahogany, the same amount of venetian red; for walnut, the same amount of brown umber.

After the substances have been thoroughly melted and mixed, the liquid should be poured on a clean surface to cool until it may be handled. While it is still quite warm, roll it into a stick between the hands. Apply to the cracks with a hot (but only black hot, not red hot) chisel.



The Home Workshop

New and Useful Things for the Practical Man to Make

A Simple Radio Receiver for Everybody

By Arnold Holmes

IN these times, when the Bureau of Markets is broadcasting daily reports of market conditions from a chain of stations all over our country, the naval stations are sending out weather and navigation reports, some commercial companies are operating radiophone stations, and thousands of amateurs are using both the radiophone and the radiograph, it behooves a good many of us to build receiving-sets, get into the game, and receive some of this valuable and interesting free information. A few dollars carefully spent will build a radio set that will bring the news of the world to our homes. It is possible that the market reports can be used in our business and the radiophone concerts that can be picked up nearly any night may take the place of our phonograph and have the added attraction that the music, though canned, is being transmitted through space from afar. It is interesting to listen to the small amateur station in your own home town talk to another possibly a thousand miles distant. This instructive hobby has proved an excellent diversion to many a great engineer and business man all over the country.

A simple receiver, having a wave-length range of from 175 to 750 meters and em-

DO you know the joy of receiving radio messages and radio concerts? Long wintry nights are ahead of us. Have you thought of sitting in your warm, comfortable room and bringing the news of the world to your ears? Nothing is more fascinating. You can do it. Only a few dollars and a few simple tools found in every tool chest are needed. Start now.

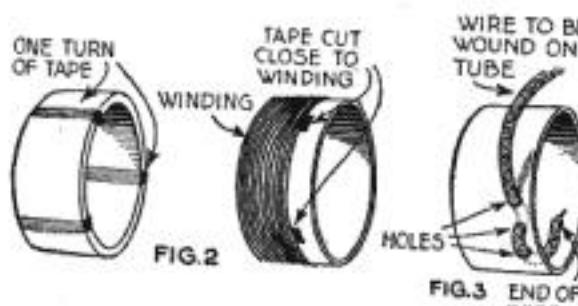


FIG. 2

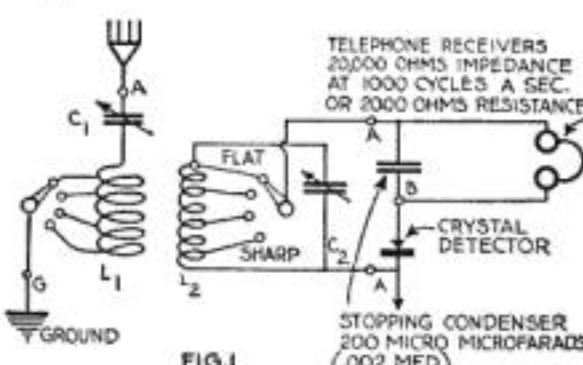
FIG. 3

END OF WIRE

A few turns of tape about the tube will prevent windings from slipping

The end of the wire should be anchored in the tube as in Fig. 3 before the winding is started

Since the receiver is only to cover the limited range of wave lengths between 175 and 700 meters, it is not desirable to use a condenser larger than 750 micromicrofarads capacity. A minimum capacity of not higher than 35 micromicrofarads (.000035 mfd.) should be obtainable in condensers of this size. With these values of minimum and maximum capacity and the coils suggested, the desired wave-length range can be obtained. It is then obvious that greater wave-length ranges can be obtained by using condensers with higher maximum or lower minimum capacities. The first table on page 85 lists a number of



How the apparatus is connected for the reception of wireless messages

ploying a crystal detector, will be described in this article. A novel means of connecting the crystal detector with the circuit so that extremely sharp tuning is possible, will also be described.

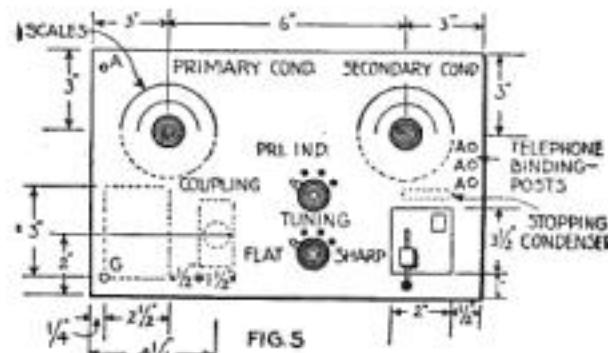
Before we can build a receiving set of any kind for a given wave-length range, it is necessary for us to know what sort of antenna we are to use, the kind and sizes of condensers that are available, etc.

For the ordinary amateur the receiving antenna should be capable of being used for transmitting as well. For this reason we have chosen a T-type antenna 35 ft. high and about 80 ft. long as the ideal. Of course, the receiver will operate equally satisfactorily on a larger or smaller antenna, but if the antenna is too large, it will be impossible to receive the shorter wave lengths, and if it is too small, the reverse will be true. Such an antenna as the one described will have a natural wave length of about 150 meters and a static capacity of about 400 micromicrofarads.

commercial condensers and their minimum and maximum capacities.

Figure 1 is a schematic diagram of the receiver circuit. The wave length of the secondary circuit is determined by the inductance coil L_2 and the adjustment of the condenser C_2 . The wave length of the antenna circuit is determined by the antenna, the inductance of the coil L_1 , and the adjustment of the condenser C_1 . The two circuits are coupled electromagnetically through coils L_1 and L_2 . The coupling is variable by rotating the coil L_2 within L_1 . The tuning of the circuit is made sharp or flat in part, by adjusting the coupling handle so that the coils are mutually perpendicular or parallel to one another.

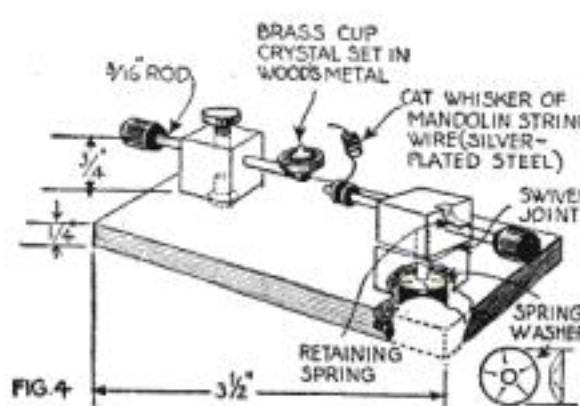
The crystal detector is generally connected across the receiving condenser so that all of the voltage of the received signal acts on the detector. Physicists who have studied the crystal detector, tell us that it has a very high resistance for weak signals and a low resistance for loud signals. Thus the condenser C_2 is shunted by a very high resistance when weak signals or no signals at all are impressed on it and a relatively low resistance when strong signals are



How the apparatus is finally mounted on the panel

impressed on it. Shunting the condenser C_2 by a resistance has the same effect as adding resistance in series with the inductance and the condenser C_2 . The lower the resistance, the greater the resistance thus added. Engineers have found that the sharpest tuning results when the resistance of the circuit made up of L_2 and C_2 is lowest. From this we see that the crystal detector connected across the condenser gives flattest or broadest tuning for the strong signal. If, instead of connecting the detector across the condenser C_2 or the coil L_2 , it is connected across only a portion of the coil L_2 , it will have less effect on introducing resistance in the circuit, and the tuning will be sharpened materially. In fact, with this arrangement, it is possible to obtain as good selectivity as can be had with the vacuum tube receiver. This method of connecting the detector to the receiving circuit is, in effect, loose coupling the detector to the secondary circuit.

The coils can be wound on cardboard, or rubber tubing. If the set is to be very well made, it is desirable to turn a thread on the



The details of the crystal detector used in connection with this outfit

tubing having the same pitch as that of the wire when wound close together. In winding coils on tubing of smooth surface material, the following kink will be found very useful: wind a single turn of friction tape around the tube longitudinally in three places (Fig. 2). This will hold the wire firmly and prevent it from slipping during and after winding. After the winding has been completed, the tape can be cut close to the winding with the aid of a penknife.

The wire can be fastened at each end of the winding by drilling three holes in the tube in line with the wire and winding it in and out as shown in Fig. 3.

The dimensions of the coils and the winding data, the capacities of the various condensers, etc., are given below:

For the crystal detector, any of the standard makes of stands may be used, and galena, radiocite, zincite, chalcopyrite, etc., used as the crystal. A satisfactory crystal-detector stand is shown in Fig. 4.

The crystal is held in a small metal cup by Wood's metal (a low melting alloy). The cup may be turned in any position by means of the knob and held in position by the set screw. The cat-whisker is adjust-

able by turning the handle or sliding the rod through the support. The brass spring is fastened to the support and presses on the cat-whisker rod so that it will stay put in any position. The rod is also capable of swinging on the swivel, which is made so that it will stay in any set position by means of the spring washer. In operating a crystal detector it is beneficial to occasionally wash the crystal with a little carbon bisulphide.

Usually panel mounting is the most satisfactory, because the panel can then be mounted in any convenient place.

A conveniently arranged panel is shown in Fig. 5. This arrangement allows the equipment (allowing for a 5-in. diameter condenser) to be mounted on a panel 10 in. by 12 in.

One of the possible arrangements of the coil mountings and details of the adjustable coupling feature are given in Fig. 5 for the convenience of the experimenter. With a set of this sort it will be possible to overhear spark stations, buzzer-modulated continuous-wave stations, and radiophone stations within the range of wave lengths specified.

COIL DIMENSIONS, ETC.				
Condenser C ₁	Min. capac. 35 M.mfd.	Max. capac. 750 M.mfd.	Capacity	
C ₂			(stopping condenser)	200 M.mfd.
L ₁	Tube dia. 3 in.	Winding length 2 3/4 in.	Total turns 105	Taps taken off at turns, Nos. 20,40,60
L ₂	2 1/2 in.	1 3/4 in.	60	15,30,45

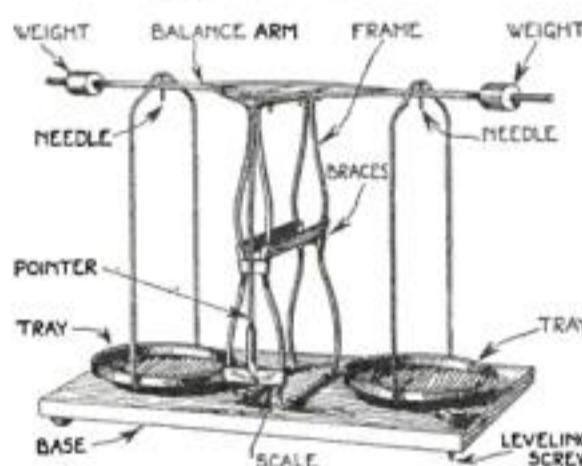
CONDENSER TABLE

List of standard commercial condensers and their approximate capacity range

Manufacturer	Approximate Minimum Cap. M.mfd.	Approximate Maximum Cap. M.mfd.
De Forrest C. V. 1503	30	1600
Gen. Radio 182 A.	20	670
182 E.	25	940
	50	1500
	60	3000
Murdock 368	20	500
366	25	870
Seibt 5500	20	640
51000	25	1100
5200	45	2300
West. Elec. Co. 46 A.	30	750
47 A.	25	225
Chelsea 1	20	530
2	35	1050

How to Make a Pair of Delicate Balances

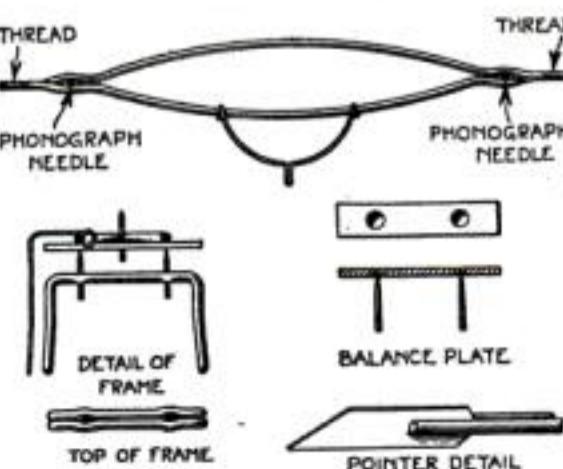
By Bert Rodson



This shows the appearance of the balances when completed in accordance with the directions given

the center, is soldered a steel plate, 1/16 by 1/4 by 2 in. The center-punch marks on the under side of this plate fit over the main balancing-points. The making of these two center-punch marks is the most delicate operation of the entire construction. The center of the punch marks must coincide within 1/1000 in. of the needle-points. A good method of procedure for the making of these indentations follows:

Procure a center-punch that has been ground to a very fine point and the point polished with emery-dust. Soften the piece of steel. (Brass may be used, but if



The balancing arm is shown here in top view, also details of the most delicate parts of the structure

so, the balances will not be as delicate.) Cover the side to be punched with chalk. Draw this chalked side across the needle-points carefully, in order not to blunt them or turn the points; then very carefully punch exactly on the fine lines left in the chalk and in the center of the strip. The center-punch marks in the strip and the balancing-points should then coincide exactly. Now reharden the strip and solder it to the center of the top cross piece.

Next, insert the phonograph needles that are to carry the trays. Thread 1 3/4 in. of each end of the beam and screw a small weight on each. These weights will make it possible to bring the scales into perfect balance. Attach a point (made from two parallel No. 16 wires) as shown in the picture. At the end of this pointer insert a piece of very thin flat steel or brass. The edge of this strip next to the scale should be ground to a knife edge so that exact reading on the scale may be taken.

The weighing-trays may be made from metal, but they may be turned from the lid of a cigar-box more easily. They are hung on No. 16 wire brackets carefully bent as shown. On the inside of the topmost curve of each bracket is soldered a small piece of steel with a center-punch mark. The tray brackets then hang from the balancing points. If the brackets have been carefully made, the trays will hang exactly level.

These balances will be found so sensitive that they should be operated in a room where no air is stirring. If the needles are perfectly sharp and accurately fit in the center-punch marks, and if the steel inserts in the top of the tray brackets are tempered until they are very hard, you will find no difficulty in weighing the amount of lead that rubs off of an ordinary lead-pencil in writing a half-page letter, or the amount of carbon dioxide taken out of the air overnight by a plant.

A good way to obtain small weights for your balances follows: Procure a thin sheet of aluminum and have it weighed exactly by a scientist or a druggist. If it weighs 100 grains, cut it into one hundred equal pieces and you will have 1-grain weights. Cut a few of these in half and a few in quarters. Cut, do not saw or file.

From the No. 10 wire carefully bend the form of the frame. The following dimensions are suggested: height 6 in., width of top 2 in., width of bottom 2 in. This frame should be bent by the aid of a vise and hammer. The two ends of the wire should be butted together and soldered under one of the curved ends of the bracing strips across the bottom.

From the No. 10 wire carefully bend the form of the frame. The following dimensions are suggested: height 6 in., width of top 2 in., width of bottom 2 in. This frame should be bent by the aid of a vise and hammer. The two ends of the wire should be butted together and soldered under one of the curved ends of the bracing strips across the bottom.

When the bending is completed, the little stiffeners made from 1/16-in. brass 5-16 in. wide, should be bent and soldered into place. Two small holes should be bored in each of the bottom straps in order that the frame may be fastened to the baseboard. On the front side of the lowest cross strip a graduated scale should be marked. The most satisfactory way of marking is by means of engraving the scale in the brass strip itself. However, the scale may be made on paper and pasted to the strip.

Next in order are the balancing points, which take the place of the knives of the ordinary chemical balances. This is one of the most exacting details of the entire construction. These points, which are phonograph needles, are fitted in the top of the frame as shown in the detail illustration, and are held exactly vertical by a bit of solder. Now, screw the frame to a baseboard planed flat and sandpapered and supported by two stationary feet and one adjusting screw as shown.

The balancing arm is made from another piece of the No. 10 iron wire. It balances on the two needle-points and carries the weighing-trays. It is 10 in. long. The tray-balancing points are spaced 2 1/2 in. on each side of its center.

On the under side of the arm, exactly in

Useful and Attractive Ornaments from Carved Clay

By E. Bade



In carving the designs in the clay, you may give free play to your imagination and artistic gifts

are dried. This is best done in some warm room or attic. Care must be taken that they are left undisturbed for at least 6 or 8 weeks. Never place them in a stove, or otherwise bake them. This only causes them to crack. The slower the drying process the better will the clay dry.

When the blocks have become thoroughly dry, they are shaved down with a knife. When they have the desired dimensions and shape, the interior must be carved out, if this has not been done with a tin can. Here great care must be taken that the knife does not slip or that the corners are not chipped off. If octagonal jars or other containers are to be made, then the blocks are first squared, and after measuring the exact size of the corners to be cut off and drawing them with a pencil on the clay, they are slowly shaved down to the required shape.

The cavities in the blocks of clay can easily be made with a brace and bit or simply by turning the point of a knife on the block; but care must be taken that no pressure is exerted. After a small hole has been made, it can be enlarged with a pocket-knife until it reaches the desired size. Never make the walls too thin; it is best to have them at least $\frac{1}{4}$ in. thick on small objects, and $\frac{1}{2}$ to $\frac{3}{4}$ in. on larger ones.

Now the most difficult and at the same time the most interesting work remains to

be accomplished. That is carving. Since the clay, when dry, is very soft, it is a comparatively simple matter to carve. Formal designs are the most difficult to make. Here the straight lines must lie in certain positions, and if slightly on one or the other side, or if one end is slightly thicker than the other, the whole appearance of the object will suffer. Although at the first glance they seem to be more difficult, the simplest designs of all are leaves, branches, and tendrils; if one line does not lie in the position it is supposed to occupy, no harm is done.

The selected designs are first drawn upon the surface of the clay, and then the clay is removed on all its sides in small pieces, preferably as dust. The design itself should stand out in relief to obtain the very best effects.

When the object has been completed to the satisfaction of the worker, it must be covered with some kind of a varnish; otherwise the clay would come off at every touch. For this purpose celluloid dissolved in acetone is ideal, especially if the solution is made very thin. The acetone forces the celluloid into the clay before it dries, and when dry the surface will be hard.

It is best to give each object two coats, the second after the first is absolutely dry and no more fumes can be detected. Great care must be taken that the acetone is not brought near a flame, since it is very inflammable.



A smoking-set like the one above will be appreciated as a Christmas present by any smoker

Moving Shadow-Pictures on the Screen Are Amusing

HAWAIIAN dancers, dancing animals, etc., shown in motion as shadow-graphs on a screen will form an attractive entertainment for children's Christmas parties. The figures of the dancers or romping animals are drawn on heavy manila wrapping-paper and carefully cut out.

The illustrations below give a number of suggestions for such figures and show how they may be cut out singly, in pairs, or in triplicate.

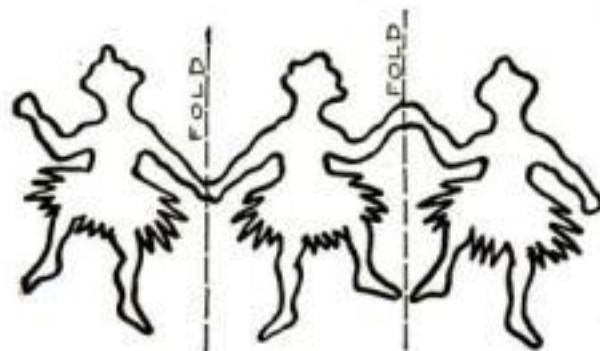
The spectators at the entertainment are all seated in the parlor. Over the door to the next room a large sheet is stretched. The lights in the parlor are turned down during the show. The figures are suspended by thin threads pinned to the sheet singly or in groups, and the enter-

tainer holding in each hand a lighted candle, stands behind the curtain and moves the lights in rhythm with the music of the piano, thus producing the illusion of the figures dancing to the music. The illusion may be aided by giving a jerky motion to the sheet.

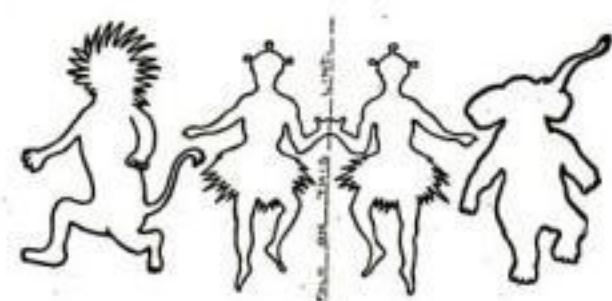
By arranging a program, it would be a simple matter to elaborate upon these dancers and to tell an interesting story with boldly defined cut-outs—in short, to produce a shadowgraph marionette show that would amuse the grown-ups of the party as much as the youngsters.



Moving the two candles in different directions with the music makes the figures seem to dance



Draw one figure, fold the paper as indicated, and after cutting along the outlines you will have three figures



Dancing lions, elephants, and other animals add to the comical effect of this shadowgraph entertainment



Get Jobs like these

MEN WANTED!

Young men mechanically inclined, get into the automobile business now and make real money. And remember you are never too old. Henry Ford was 40 when he started the Ford Co.

SWEENEY trained men are in demand everywhere at good wages, \$50 a week and more, from garages, tire shops, welding concerns, auto repair shops, etc. In the last six months farm products have all gone down, but the autos still kept running and no trained mechanic had to hunt a job. Top wages are paid, but SWEENEY TRAINED MEN ARE WANTED. Here's the proof:

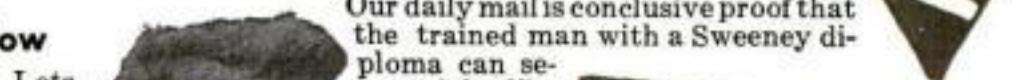
Hundreds of Openings For Men!

Business Is Better!

Young man, be independent. Strike out for yourself. Hold up your head. On the skyline of Opportunity see the Sweeney School. We are TRAINERS OF MEN, ARCHITECTS OF SUCCESS. I have made a million dollars in fifteen years BY MAKING OTHERS SUCCESSFUL. Take your first step toward success by writing me today. Over 46,000 successful graduates.

South Dakota wires: "Will pay most any price for a good man. Send him right away." Neck City, Mo., says: "Put us in touch with a first class repair man. Excellent opening." Indiana says: "Want one more Sweeney man for my new garage. Steady work at good prices." Kansas appeals: "Send me a man who understands Ford Car from A to Z. Will pay top wages." Mississippi telegraphs: "Want a post graduate mechanic. Will pay all he is worth. Wire at my expense." Florida calls: "Want head mechanic. Will pay \$50 a week. Let me hear by return mail." Thousands of Sweeney graduates now owning their own business in various parts of the country naturally favor the Sweeney trained men. Sweeney loyalty is wonderful.

Our daily mail is conclusive proof that the trained man with a Sweeney diploma can secure jobs like these at \$50.00 a week and more.



I'll Pay Your Railway Fare to Kansas City!

My Big Announcement this season—

You can come to the world's largest and best trade school at no more expense than if it were located in your home town, for I am rebating fares from any point in the U. S. to the Sweeney School. No advance in tuition, no extras. Just a fair square rebate. No matter where you live, this brings the Sweeney Million Dollar School to your door.

Thousands upon thousands of young men thought as you have been thinking about MECHANICAL TRAINING, and they answered my advertisements, got my Big Free Catalog, came here, learned the business, and today, in all parts of the country ARE MAKING GOOD. I can give you hundreds of letters from these men that relate circumstances and hopes so like your own that you will be amazed.

These men TOOK THE FIRST STEP. They wrote for my catalog, and date their present success from that moment. They will tell you:

"Don't make any mistake. Take up the Auto Business. Learn it right. LEARN IT AT SWEENEY'S."

But These Men Never Had the Opportunity You Have Right Now

The railroad fare to Kansas City is a big item. Lots had to pinch and scrape to make it. **But I will now pay your fare.**

But you must COME NOW. I don't know how long I will keep this offer good. Because I WONT ACCEPT MORE MEN than I can properly handle and give the attention to them that the Sweeney System demands. I've got over a quarter million dollars worth of equipment in the largest trade school in the world, covering 12 acres of floor space—but there's a limit to all things. And when that limit is reached—I'll withdraw this Free Fare Offer.

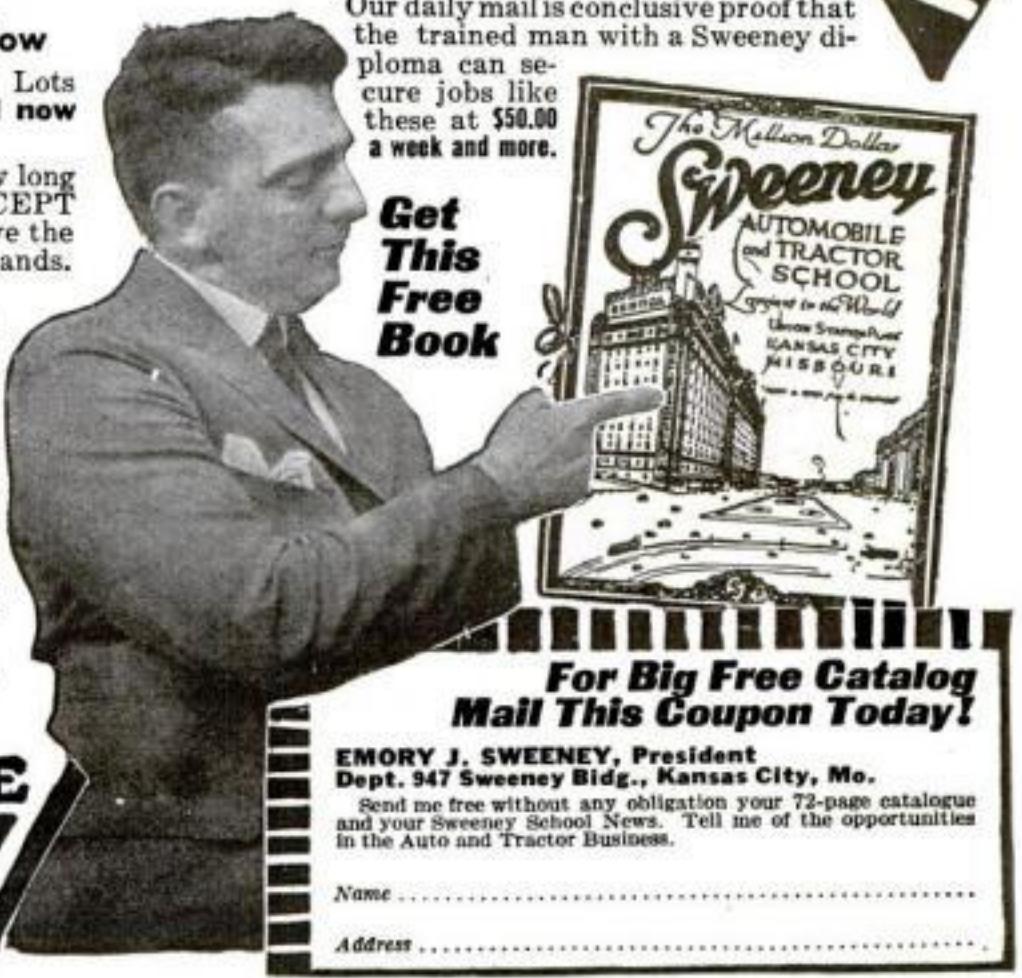
Free

I will gladly send my 72-page illustrated catalog FREE. Also a free copy of the Sweeney School News, a most interesting monthly school paper published here. You will enjoy them. Read the worth-while stories of men like yourself who came to Sweeney's and found success. Read how Frank Powell and Harry Wilson built up a \$20,000 business in about two years after graduating. Read how Elbert A. Pencee built up a \$25,000 yearly garage business at Clearmont, Mo. These stories and others are told by the Sweeney students. Also I want you to learn how my students enjoy themselves after work in the swimming pool, the club and reading rooms, etc.

EMORY J. SWEENEY, President.

Send Coupon Right Now!

LEARN A TRADE
Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
947 SWEENEY BLDG. KANSAS CITY, MO



For Big Free Catalog Mail This Coupon Today!

**EMORY J. SWEENEY, President
Dept. 947 Sweeney Bldg., Kansas City, Mo.**

Send me free without any obligation your 72-page catalogue and your Sweeney School News. Tell me of the opportunities in the Auto and Tractor Business.

Name _____

Address _____



"WALLY" REID

Star of the Movies, Plays a

BUESCHER

True-Tone Saxophone

While not classed as a musical star, Wallace Reid's Saxophone affords him much pleasure in home entertainment. His decision to purchase a Buescher was made after knowing it to be the

Choice of Professionals

such as Tom Brown of the Six Brown Brothers; Clyde Doerr of the noted Art Hickman's Orchestra and Columbia Record Maker; Donald Clark, expert Saxophonist with the celebrated Paul Whiteman's Orchestra; J. Gurewich, Saxophone Soloist with Sousa's Band, and many others. More Buescher Saxophones are used than the combined product of all other manufacturers, because they are

Easiest to Play

You can learn the scale in an hour's practice and play popular music in a few weeks. Practice is a pleasure because you learn so quickly. You can take your place in a band within 90 days, if you so desire.

Unrivalled for home entertainment, church, lodge or school. In big demand for orchestra dance music. A Saxophone will enable you to take an important part in the musical development of your community. It increases your popularity and your opportunities, as well as your pleasure.

Saxophone Book Free

"The Origin of the Saxophone" is an interesting booklet. It illustrates the beginner's first lesson. It tells what each Saxophone is best adapted for; when to use singly, in quartettes, sextettes, octettes, or in regular band or full Saxophone Band. Tells how to transpose for 'cello parts in orchestra. It illustrates and fully describes the virtues of each model of the Saxophone Family. Ask for your copy.

Thousands of the most successful professionals use Buescher Cornets, Trumpets, Trombones and other Band and Orchestral Instruments.

Free Trial-Easy Payments

You can order any Buescher instrument without paying one cent in advance, and try it six days in your own home, without obligation. If perfectly satisfied, pay for it on easy payments to suit your convenience. Mention the instrument interested in and a complete catalog will be mailed free.

(30)

BUESCHER BAND INSTRUMENT CO.

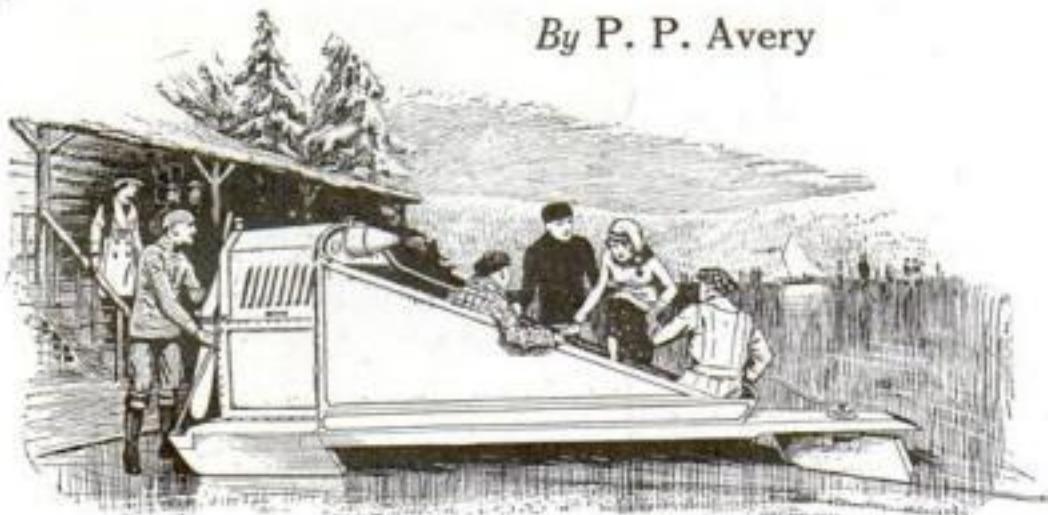
Makers of Everything in Band and Orchestra Instruments

3130 Buescher Block Elkhart, Indiana

THE HOME WORKSHOP

Build Your Own Air-Driven Sled

By P. P. Avery



All aboard for a delightful trip through the crisp winter air with this propeller-driven sled

GOOD looking as is this homemade ice-flyer, it is not expensive, as it can be made from used parts that a mechanic always has lying around his workshop. Its novelty and speed will make a strong appeal to all lovers of outdoor sport.

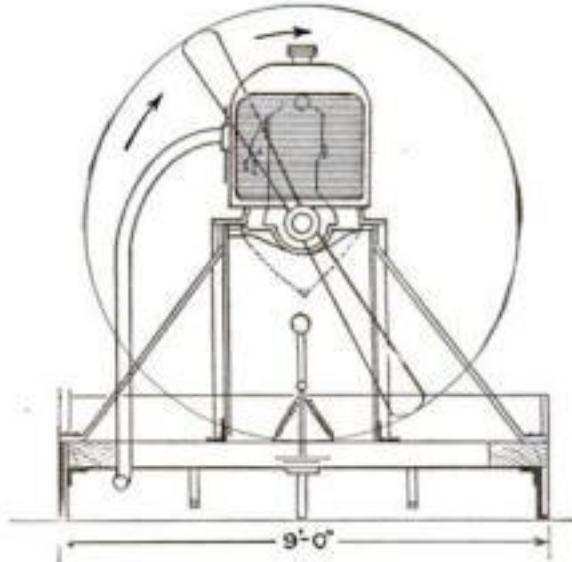
And now for the construction. First, look around for some spruce wood and from it build three 2-in. runners. Be sure that the spruce is well seasoned and that it has no knots in it. As soon as you have completed the runners, apply two or three coats of the best spar varnish.

For the motive power a good second-hand Ford power plant could be used. At the end of the elongated crankshaft is placed the 6-ft. propeller. The old Ford transmission is dismembered, all useless parts are removed, and sheet-iron plate is placed over the universal-joint housing.

The engine is set on an angle-iron foundation as shown. All unnecessary parts are discarded, such as the fan, for instance, as the radiator receives plenty of air. The exhaust pipe is elongated and carried to the back of the sled, as shown.

The frame of the air-sled is of 6 by 10 in. spruce reenforced by 1/4-in. bolts and corner-clips all around.

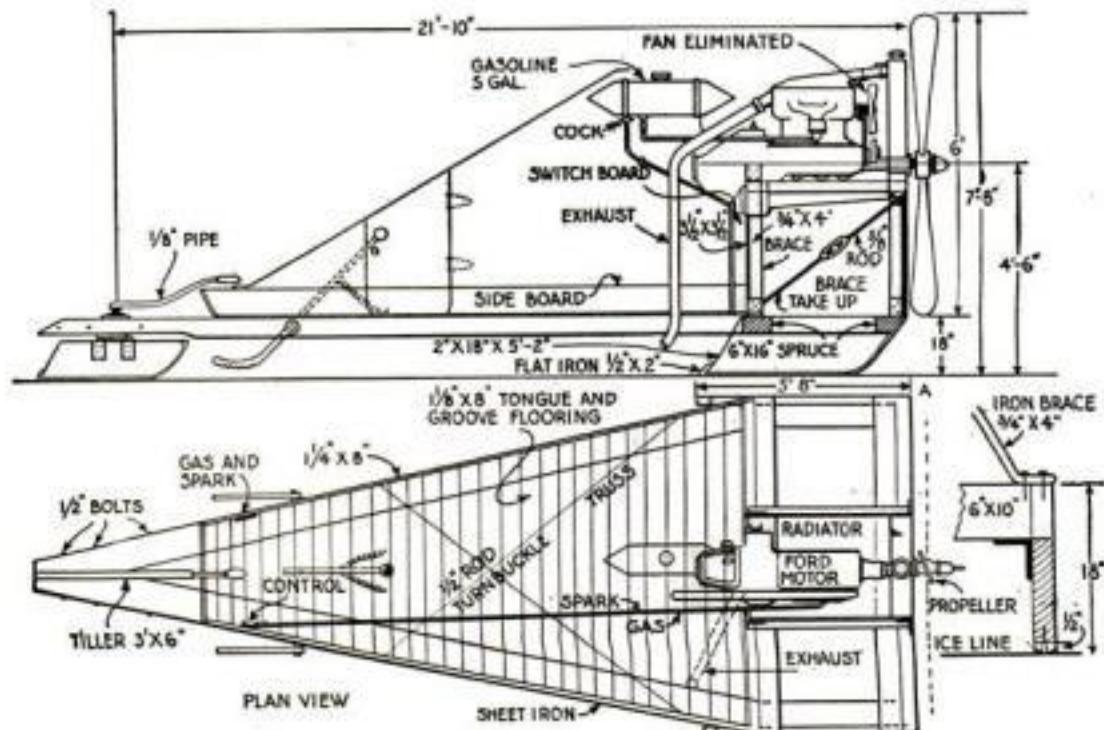
The rear sled is for steering and braking. It is pivoted on a vertical axis that has a 1 1/2-in. pipe handle. A strong spiral spring is placed around this steering-post, between the rear end of the platform and the steering-sled. This allows for unevenness



Front elevation of the air-driven ice-sled, showing the framework supporting the engine

in the ice surface. The side bands are of 1 1/4-in. pine and the flooring is nailed or screwed to its base. One-inch quarter-round strips are nailed along the edges. Battery plus magneto ignition is preferable to any other.

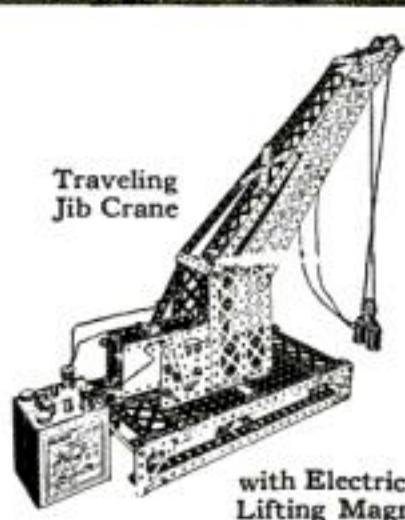
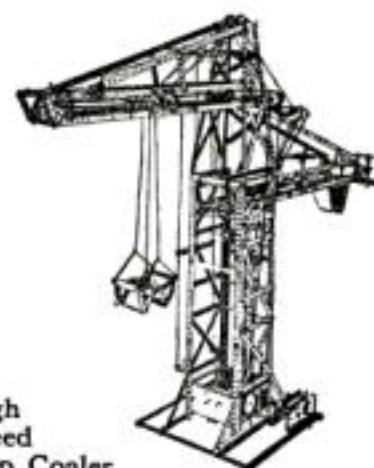
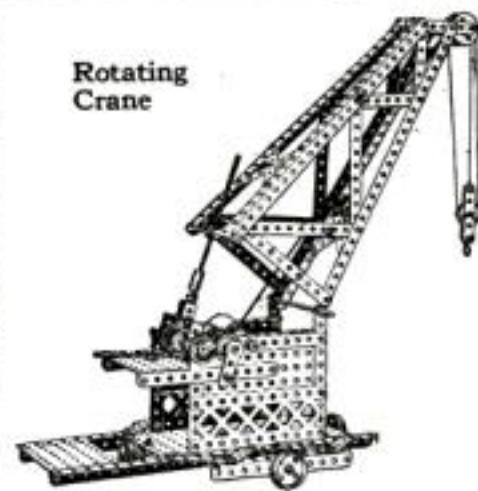
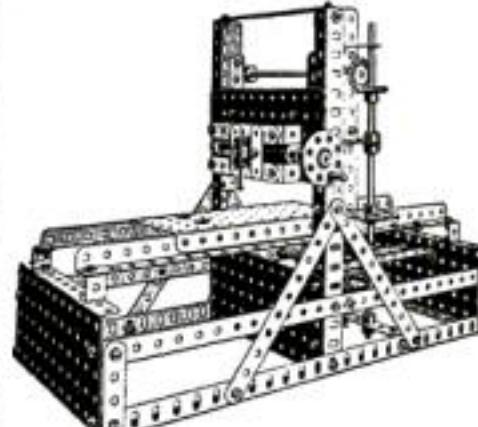
When finally you have completed the sled's construction, the body should be given two coats of the best spar varnish and two coats of American white lead on all other parts. A gray and black striping for the floor and the runners will give your new conveyance a professional finish.



Side elevation and top view of the sled are here shown. The dimensions given are merely tentative and may be changed to suit conditions

MONDAY

Ferris Wheel

TUESDAYTraveling
Jib Cranewith Electric
Lifting Magnets**WEDNESDAY**High
Speed
Ship Coaler**THURSDAY**Rotating
Crane**FRIDAY**

Planing Machine

SATURDAY

Gantry Crane

with **MECCANO**

Any boy can build Cranes, Bridges, Airplanes, and all kinds of machines, and then make them work like real machinery with the Meccano electric motor. The big Book of Instructions in each outfit makes everything clear even to the youngest boy.

Send for This New Meccano Book



**FREE
TO BOYS**

It describes Meccano and tells interesting things about model building. Every page a pleasure. Sent free if you send us names and addresses of yourself and three chums. Put No. 36 after your own name for reference.



MECCANO COMPANY

INCORPORATED

Div. K, 71 W. 23rd St., New York City



**\$1250
PRIZE
CONTEST**

Ask your dealer for
Free Entry Blanks
or Write Us

About the Care of Dry Cells in the Country

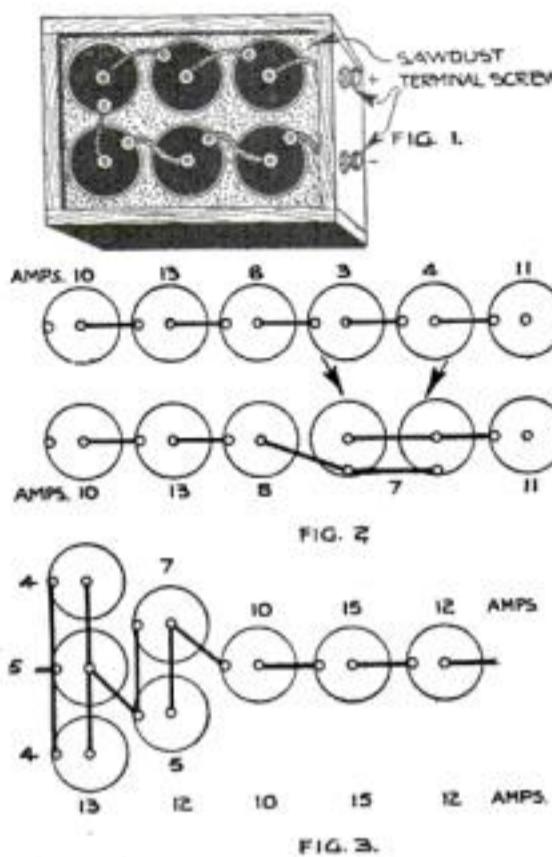
By A. J. Christopher

DRY cells, whether for one purpose or another, are used in almost every country place. They make the spark that lights your gas and runs your engine, they ring your doorbell, operate the burglar alarm, and perform other duties too numerous to mention.

Dry cells should be kept dry and clean and slightly warm in order to give satisfactory service. When they are purchased, it is well to give the zinc cases a coat of shellac or varnish so as to make them as damp-proof as possible and to prevent corrosion from the outside. The paper containers should be replaced, to further protect the batteries.

Cells that come in units of three or more are sealed in a pitchy compound to eliminate moisture, loose connections, and short circuits. If it is desirable to make your own "units," make light boxes large enough to hold the cells and line them with heavy paper. Place $\frac{1}{2}$ in. of dry sawdust on the bottom and put in the batteries. With a wooden stick pack in all the sawdust you can to the top of the cells and connect them with No. 14 insulated wire, making sure that the wire is scraped clean and that the nuts are tight. Use the pliers for this. Then finish filling the box, fold over the paper, and attach the wire leads from the batteries to two binding-posts placed near the top on one side of the box. The cover may now be fastened. A piece of "strawboard" placed beneath and above the cells would act

as a shock-absorber and would provide an air space, but it is not necessary. The box may be painted. The batteries



Several methods of connecting dry cells that will prolong their life are shown here

will last much longer if protected in this manner.

For the gas-lighting coil, four to six cells in series are usually used, and for engine ignition from three to ten. In this work they function properly only until one or more drops below five or six amperes. These run-down cells then cause resistance in the circuit and the coil, not receiving the proper amount of current, cannot produce a fat spark. When the dry cells that operate a coil seem to be weak and, upon testing one or two, are found to be below normal, connect the two weakest cells as shown. Unless they are entirely exhausted they will give a little more service.

A number of partly run-down cells may be connected in multiple series and will last a while longer. On farms where gas is employed for lighting, each building or group of buildings has its batteries and coil. About once a year these batteries are replaced. Those removed should be tested. All showing four amperes or better should be kept and connected in multiple series. Always arrange them so that each cell or multiple of cells placed in series test around ten amperes. When connected in this manner, batteries that would otherwise be discarded will give service for from two to six months on a gas-lighting circuit.

An ammeter test, if taken from the leads of the series-connected batteries, is unreliable, as it does not show a weak cell if one should be run down. Each cell, therefore must be tested individually.

Oil-Filter for the Farm or Shop

EFFICIENT and handy is this filter for oil. It can be made in the farm workshop from an ordinary wooden barrel, as shown in the accompanying illustration.

The head is removed from a barrel and a cover is made to take its place. A circular hole 6 in. in diameter is made in the center of this cover. A 5-gal. round, conical top oilcan, in an inverted position, which serves to feed the oil to the filter, is placed in this hole. The bottom of this can is cut out smoothly and is perforated with small holes made by the point of a small nail. This old can bottom is then dropped into the can and rests on the flare of the conical top.

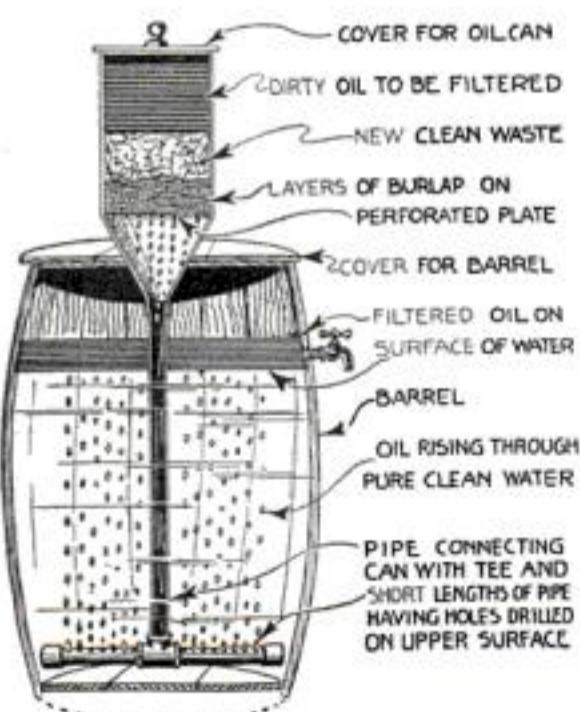
Into the mouth of the can is soldered a

short piece of small-sized iron piping to other tubing that extends near to the bottom of the barrel. To the threaded end of the pipe a T is screwed and a short piece of the same size piping is threaded into each side of the T to extend horizontally almost to the walls of the barrel. In the upper sides of these short pieces of piping are cut several small holes for the escape of the oil. The ends of these short pieces are plugged up with cork stoppers.

On the perforated plate in the oilcan several layers of felt or burlapping are placed. On top of the burlapping is laid a bunch of new, clean waste, as shown in the illustration. This fills the can about half full and the remaining space receives the oil. The oil is then poured in on the waste in the top of the inverted can.

The barrel is filled two thirds full of pure, clean water and is provided with a bibcock that is 1 in. above the level of the water in the wall of the barrel. A cover is made for the top of the oilcan. It is obvious that the oil seeps down through the waste, through the burlapping and the perforated plate by force of gravity. Thence it descends through the perpendicular pipe out through the short, horizontal pieces of piping attached to the T union and emerges, a drop at the time, from the small holes made in their upper sides, rising to the surface of the water in the barrel, which helps to refine and clean the oil.

As soon as enough oil has been filtered to rise to a level with the bibcock in the side of the barrel, it may be drawn off as needed. The supply of waste and burlapping can be replenished with little difficulty when it has become polluted with foreign matter.—L. M. JORDAN.



Every farmer who uses machinery may save money by constructing and using an oil-filter like this

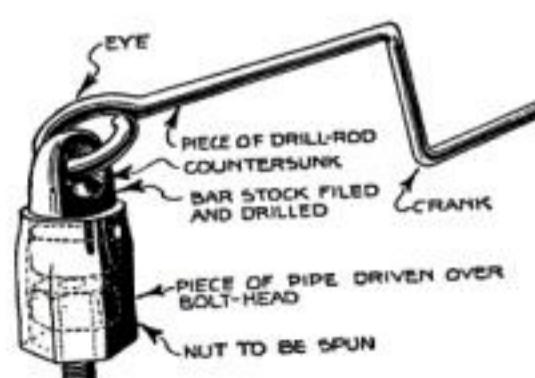
Shopmade Speed Wrench of Simple Construction

A SIMPLE form of jointed speed wrench for a small shop is worth duplicating, being of especial advantage in getting around almost any form of interference due to pumps, wires, and pipes. This wrench is not used to start or finish the bolt turning, but is for the express purpose of spinning them off.

A heavy open-end wrench is used to start the bolt and this speed wrench is slipped on, when a quick job of removal is made. To make the wrench, use a 1- or $1\frac{1}{2}$ -in. length of pipe. Drive this over the bolt head and flatten up the sides to a fair fit.

Use a piece of round stock and after drilling through one end, countersink from each side and round the end over as shown. Rivet this into the socket. Make the handle as shown, with a crank end and an eye to engage the eye made in the socket plug.

To use, hold the handle in the left hand and turn the crank with the right. This wrench is particularly useful for removing cylinder-head bolts, especially those of a V-type eight- or twelve-cylinder motor.

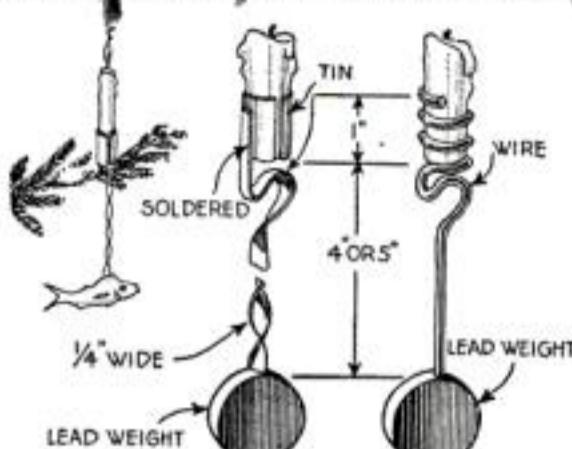


Here is shown a simple form of a homemade speed wrench which will be found very useful

THE HOME WORKSHOP

Christmas-Tree Candle-Holders that Always Hang Vertically

FOR the Christmas-tree, here is shown an easily made candle-holder that will hang upright anywhere on the tree. It can be made of wire or tin plate, with lead or rabbit weights to hold the candles.



Candle-holders of this type are easily made and will always hold the candles in vertical position

upright. The weights can be cast in many designs, such as fish, or other animals, fruits, etc. They can be cast in plaster of Paris molds direct to the holders and may be painted with gold or aluminum enamel.—LOUISA A. CAPPEL.

Build Your Woodbox Under the Stairs

NEAR the living-room stove is a woodbox that is large enough to hold wood for the entire day, and it is never in the way, since it occupies a space that was formerly unused under the lower part of the stairway.

A small door in the living room wall gives convenient access to the wood.

The box is filled from the foot of the stairs. This is made possible by removing



A woodbox under the stairs will make the housework easier for the housewife

the entire fifth step and the top or horizontal section of the fourth, and fastening them together securely with screws and iron strips, bracing and reinforcing the corners both inside and out. This is the lid of the woodbox. It is hinged in place. Strong wooden supports were nailed to the wall on either side for the steps to rest on when the box is closed.

To prevent falls and accidents on the stairs, the lid must be kept closed except when the box is actually being filled. So the lever shown in the line drawing is to open the box when stepped upon and to permit the box lid to close automatically when the foot pressure is removed.



This New Way

Now beautifies teeth half the world over

Millions of people, half the world over, now clean teeth in a new way. Modern authorities approve it. Leading dentists everywhere advise it.

This is to offer a ten-day test. The results will surprise and delight you. And they may lead, for you and yours, to life-long benefits.

Write for this free test.

That dingy film

That viscous film you feel on teeth causes most tooth troubles. It clings to teeth, gets between the teeth and stays. It dims the teeth and often leads to ruinous attacks.

Film absorbs stains, making the teeth look dingy. It is the basis of tartar. It holds food substance which ferments

and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. Also of many diseases.

Old brushing methods do not end that film. So very few people have escaped some form of film attack.

Now ways to combat it

Dental science, after diligent research, has found two film combatants. Able authorities have proved their efficiency. Now peoples of many nations use them daily, largely by dental advice.

The methods are embodied in a dentifrice called Pepsodent. And a 10-Day Tube is being sent to every home that asks.

Watch these five effects

Pepsodent does more than fight film. It brings other results now believed essential, in view of the average diet.

It multiplies the salivary flow—Nature's great teeth-protecting agent. It multiplies the starch digestant in the saliva—put there to digest starch deposits that cling. It multiplies the alkalinity of the saliva—Nature's neutralizer of the acids which cause decay.

Pepsin is also included.

This ten-day test will 20 times repeat all the effects. And you will gain a new idea of what clean teeth must mean.

Send the coupon for the 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coats disappear.

You will always want your teeth, we think, kept that white, safe and clean. This is too important to forget. Cut out the coupon now.

Pepsodent PAT.OFF.
REG. U.S.

The New-Day Dentifrice

A scientific film combatant, whose every application brings five desired effects. Approved by highest authorities, and now advised by leading dentists everywhere. All druggists supply the large tubes.

Ten-Day Tube Free ⁶⁷³

THE PEPSODENT COMPANY,
Dept. 329, 1104 S. Wabash Ave.,
Chicago, Ill.

Mail 10-Day Tube of Pepsodent to

Only one tube to a family.

1000 Things You Ought to Know

EVERY day in your work you get up against new problems—sometimes it is only some old "sticker" coming in a new way. Just the same though it takes a lot of time to figure them out. **Don't do it.** Here's everything worked out for you. Every problem big or little that you will meet in a day's work. Hundreds of new ideas and better ways of doing things. Hundreds of ways the other fellows are making money. Hundreds of ways you can make more out of the same work you are doing now.

Cyclopedia of Carpentry and Contracting

Five great big volumes bound in genuine American Morocco with 2158 pages and more than 1000 blueprints, plans, pictures and diagrams. It is the newest, most complete, most practical work of its kind ever published. Twenty-five well known experts prepared these great books, gathering the material from hundreds of different sources. Every man in the shop and on the job should have them.

The old days of hit-or-miss experience are passed. You have got to know if you want to keep in the running now. A little of your spare time and the Cyclopedia of Carpentry and Contracting will put you way ahead of the rest. See our FREE trial offer and easy payment plan below.

FREE EXAMINATION 8 MONTHS TO PAY

Send the coupon for these great Carpentry and Contracting books TODAY. You can't afford to be without them and you don't take any risk at all. The coupon brings the whole set by express collect for a week's free examination. Use the books a week and notify us to get them back if they don't please you. If you like them send us only \$2.80 in 7 days and \$3.00 each month until \$24.80 is paid. Send the coupon NOW and get the consulting membership free. This part of the offer will be withdrawn when the membership is filled. Remember—sending for the books does not obligate you to buy.

American Technical Society
Dept. G-209
CHICAGO



Free Examination Coupon

American Technical Society
Dept. G-209
CHICAGO

Please send me the 5 volume Cyclopedia of Carpentry and Contracting, shipping charges collect. I will send you \$2.80 in seven days and \$3.00 each month until \$24.80 is paid or notify you to send for the books at your expense. If I buy the books I get a membership in your society free.

Name.....
Address.....
City..... State.....
Reference.....

Please fill out all these lines

THE HOME WORKSHOP

New Prize Contest "How I Made Money with My Tools"

HAVE you ever made extra money with your tools? If you have, we want to know just how you did the trick. If you constructed something, describe it. If there is a particular job that you do, let us know what it is. For instance, we have heard of a chap who mends furniture in his neighborhood during his spare time. Others have established small spare-time businesses with tools as their only investment.

Sit down now and describe your own experience for the readers of Popular Science Monthly. If you have photographs or drawings of the things you have made or the job you do, send them along.

Tell your story as humanly and interestingly as possible.

\$90 in Prizes

Popular Science Monthly intends to make this worth your time. If you do not win one of the three big prizes it is possible that your article will be bought at space rates. First Prize will be \$50; Second Prize, \$25; and Third Prize \$15.

Conditions of the Contest

(1) Contestants are not limited in the number of ideas. The contest is open to everybody.

The second prize of \$25 will be paid to the contestant who submits an idea next in merit.

(2) If a drawing is sent in, it need not be made by a skilled draftsman. The contestant's name and address should appear on each sheet of drawings.

The third prize of \$15 will be paid to the contestant who submits an idea third in merit.

(3) Drawings and photographs must be accompanied by a description, preferably typewritten, in which the subject is clearly explained. The MSS. must be written on one side of the paper only, and should not be more than 500 words in length.

(7) The winners of the contest will be announced in the earliest possible issue of Popular Science Monthly, and their articles will appear later.

(4) Drawings and descriptions entered by contestants must be received by Popular Science Monthly not later than 5 p. m., on January 20, 1922.

(8) The editors of Popular Science Monthly shall have the right to publish meritorious manuscripts that do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(5) The judges of the contest will be the editors of Popular Science Monthly.

(9) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(6) The first prize of \$50 will be awarded to the contestant who, in the opinion of the judges, has suggested the best idea.

(10) Send drawings and specifications to the Editor of the Making Money with Tools Contest, Popular Science Monthly, 225 West 39th Street, New York City.

Bench-Hook and End-Wood Planing Device

WHOEVER has attempted to plane the ends of small thin strips of wood will appreciate this handy little device. It is constructed of hard wood.

A is a block of wood cut like a miter-box, which is screwed and glued to the body **B**. This block also serves as a support when planing.

B is the body upon which the board to be planed rests.

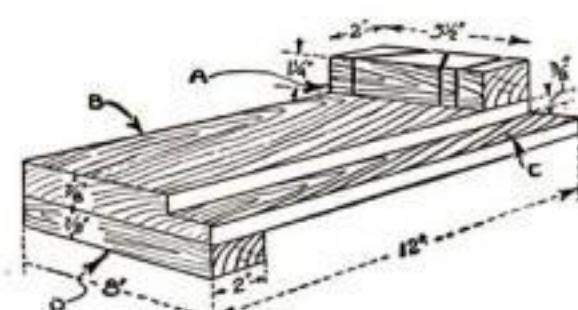
C is a flat-like groove cut from **B**, in which the plane slides back and forth.

D is a support that is screwed and glued to **B** to keep the bench-hook from sliding all over the bench when used.

To plane the ends of a piece of wood, place the wood on the body **B** and against block **A**; then lay the plane on its side so the cutting edge is vertical. Then push the plane against the wood to be cut,

pushing from you. The plane slides in the groove **C**.

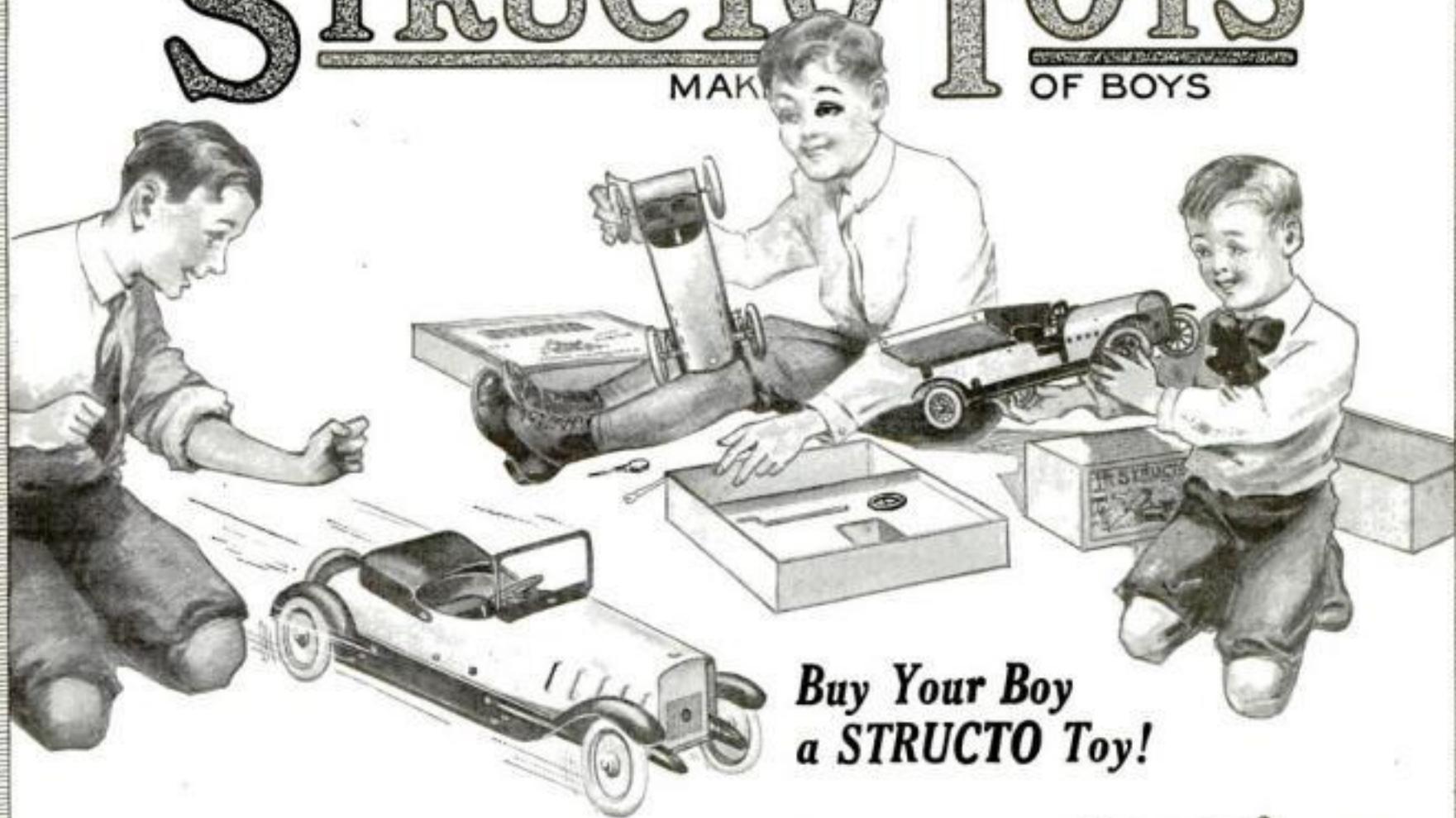
A screw-eye can be placed in the top of the body **B**, so that the device may be hanged on the wall when not used. The illustration gives the dimensions.



This little device on your workbench will make it easy for you to plane the ends of small strips

STRUCTO TOYS

MAKING TOYS FOR BOYS

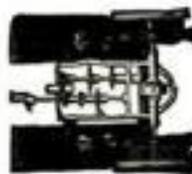


*Buy Your Boy
a STRUCTO Toy!*

Build Structo Autos that Look and Run Like Real Cars!

BUILDING a STRUCTO Automobile, Truck or Tractor is fine sport for any boy. These toys are realistic reproductions of real automotive machines. They have parts like real cars. You assemble the parts and build your own Auto, Truck or Tractor. You can build a fast, sporty, Racing Car; a classy Roadster, a big Dump Truck or a sturdy Tractor. STRUCTO models run fine, too! They have strong, powerful motors that drive them straight ahead or around in a circle; up hill or on the level. Some have sliding gear transmission and regular "big car" differential, with gear and brake levers; others have direct shaft drive, while the Tractors have directly connected gears that give them pulling power for slow speed work. They all have many features of real cars, and are handsome, strong, sturdy machines you can have a lot of fun with. They are so well made they last a long time.

There are six fine models to choose from: Nos. 8, 10, 11, 12, 14, and 16; all pictured here. Any boy can build them; all the work is done. Just put them together and you'll have an Automobile, Truck, or Tractor that looks and runs just like a real one! Look over these models; read the specifications for each one and decide which you're going to have. Any fellow's Dad will be glad to see him build a STRUCTO Auto because it helps him understand how real autos are made.



Just like a Real Car! The No. 12 Model has transmission and differential shown above. All these toys have parts like real machines.

There are also four dandy Ready-Built STRUCTO models; Nos. 40, 42, 44, and 48. These are ready built for you and ready to run when you get them. They're wonderful machines and have strong motors that keep them going a long time. The Caterpillar action of the No. 44 Tractor and the No. 48 Tank is very realistic and these toys have remarkable power for their size. Finished in colors and very attractive in appearance and action. Each one comes in its own box.

Ask for STRUCTO TOYS in the Toy Department, Hardware Store, Toy Store and any store where good toys are sold. Be sure you see the name "STRUCTO TOYS" on the box because then you'll have the best ones. If you cannot find the one you want we will fill your orders direct, upon receipt of price listed.



Roadster Auto: Ready-Built Model No. 40. A strong, speedy car, 10½ in. long. Red with black trimming. - - \$3.50

STRUCTO MFG. CO., Freeport, Illinois

West of Denver, Colorado, and in Canada, prices are 10% higher.



Contractor's Dump Truck: Ready-Built Model No. 42. Has body lifting and lowering lever. 12 in. long. Orange with black and nickel trimming. - - - \$4.25



Caterpillar Tractor: Ready-Built Model No. 44. 11½ in. long; very realistic in action. Disc harrow included. Green and red with black trimming. \$5.00



Caterpillar Whippet Tank: Ready-Built Model No. 48. 12 in. long. Gray with red trimmings. Gun mounted in turret - - - \$5.00



Structo De Luxe Auto: Auto-Builder Outfit No. 12. Just like a real car! 16 in. long. Triple-unit motor, "big car" transmission, and differential; clutch and brake levers. Two speeds forward and one reverse. Disc wheels, low body and other regular car features. Orange and black colors. \$10.50



Yuba Tractor: Tractor-Builder Outfit No. 16. A perfect reproduction of a well-known tractor. Powerful double-unit motor; control handle and stop and start lever. One trailer included. 20 in. long over all. Blue and red color. \$8.50



Structo Racing Auto: Auto-Builder Outfit No. 8. A fast, sporty racer, 16 in. long. Green color, black trimming. \$5.50



Structo Bear Cat Auto: Auto-Builder Outfit No. 10. A sturdy powerful roadster, 16 in. long. Single-unit motor; direct shaft drive. Start and stop lever. Red color, black trimming. - - \$7.50



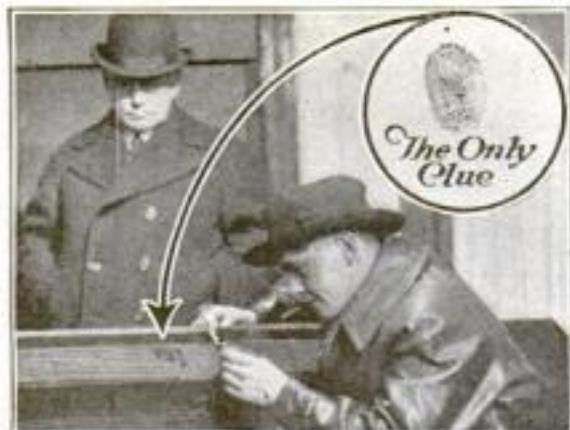
Structo High Wheel Tractor: Tractor-Builder Outfit No. 11. Triple-unit motor. Start and stop lever. Most powerful tractor of its size. Green color, red wheels. One trailer included. \$7.50 Extra Trailers - - - \$1.00 each



Structo Dump Truck: Truck-Builder Outfit No. 14. Triple-unit motor; sliding-gear transmission; forward and reverse speeds. 18 in. long. Has dumping attachment. Red color. - - - \$12.00



Copyrighted material



\$500 REWARD for TWO HOURS WORK

In answer to a request from Chief of Police, Warren Biglow, the Finger Print Expert arrived at the scene of the daring robbery of the O—Company offices. \$6500.00 in currency was gone. Not a single clue had been found.

Almost immediately Biglow turned his attention to a table which had been tipped up. The glossy mahogany showed an excellent set of finger prints. *The thief might just as well have left his calling card.*

To make a long story short, his prints were photographed, and matched with those of "Big Joe" Moran, a safe blower. Moran was caught and convicted on Biglow's finger print proof. The money was recovered and a \$500.00 reward given to Biglow, in addition to his fees—as pay for his two hour's work.

Be a Finger-Print Expert Learn at Home in Spare Time

No more fascinating work than this—and big rewards go to the EXPERT. Thousands of trained men are now needed. The Finger Print work of governments, corporations, police departments, detective agencies, banks, individuals, has created a new profession. Many experts earn \$3,000.00 to \$10,000.00 a year. And now you can easily learn the secrets of this new science in your spare time—at home. Any man with a common school education can become a Finger Print Expert in a short time.

Free Finger-Print Outfit and Large Illustrated Book

We are making a special, limited offer of a complete Professional Finger Print Outfit and a Course in Secret Service Intelligence, both absolutely FREE. Mastery of these two professions offers you a brilliant career. Write quickly for illustrated free book on Finger Prints which explains this wonderful training in detail. Don't wait—mail the coupon NOW. You may never see this announcement again.

University of Applied Science Desk 1369, 1920 Sunnyside Ave., Chicago

University of Applied Science Desk 1369, 1920 Sunnyside Ave., Chicago, Ill.

Gentlemen: Without any obligation whatever send me your new, fully illustrated, FREE book on Finger Prints, and your offer of a FREE Course in Secret Service Intelligence.

Name..... Age.....

Address.....

Town..... State.....

Earn \$2500 to \$5000 a year

Be a Signal Engineer

Qualify at home in spare time for a big position as Signal Engineer. Get into this great new field of fascinating work where quick success, swift promotion and a high salary await you. Railroads everywhere need men who understand Signal Engineering and electrical safety devices.

Book FREE

Send quick for big illustrated book on Signal Engineering and details of our great Free Outfit Offer and our wonderful system of training which includes a Complete Course in Practical Electricity and Mechanical Drafting. Send postal today. Don't delay! Get it now!

DEPARTMENT OF SIGNALING, Dept. 1369
1924 Sunnyside Ave., Chicago, Ill.



SIGNAL
ENGINEERING

THE HOME WORKSHOP

A Boring Table for the Small Lathe

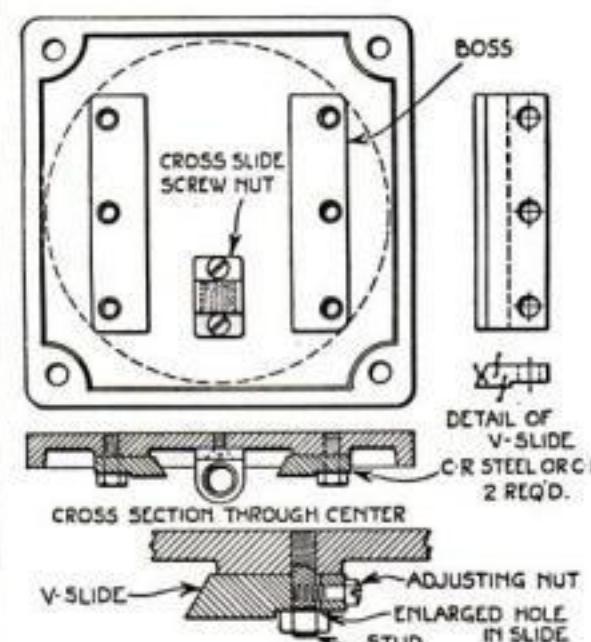
A BORING or milling table is a useful accessory to the small lathe and the illustrations show how one may be made and fitted to the lathe cross-slide, using the original cross-feed screw. No planer or shaper work is required as all work is performed either in the lathe itself or on the bench.

The device consists of a cast-iron table, either with a plain top or with slots cast in place, as the builder desires. The lower side of the table has a ledge around it to add strength and two lower bosses to which the V slides are bolted. Corner bosses, with holes through them, are shown; these, in the original apparatus, were intended to take a $\frac{1}{4}$ -horsepower motor with a grind-

iron plate. As the position of the feed-screw nut, if cast in place, would in all probability interfere with the machining of the bosses, this is made separately, tapped or threaded and screwed to the bottom of the table. Two V slides are made, either of cast iron or from cold-rolled steel stock; if the latter, the V slides must be filed or sawed to shape. Cast-iron V slides will have to be file-finished on the surfaces that bear on the cross-slide V's. They could be bolted to the face-plate and faced off in the lathe or ground on a high-speed abrasive grinding-disk.

The table casting itself is drilled and tapped for four holes, in the corners or otherwise, and bolted to the lathe face-plate and faced as nearly as possible to a plane surface; it is then reversed and the two under bosses are faced off. Next, the V slides are bolted in place, one of them being made adjustable after the somewhat novel method shown. Steel studs are set into the table and the V slide is set up by nuts on the ends of the studs. The holes in the slide are larger in diameter than the studs or are filed lengthwise to allow of a small amount of take-up. Smaller holes are drilled in the outer edge of the slide and corresponding ones drilled and tapped through the studs to take fillister-head machine-screws. To adjust the slide, the lower nuts are slightly loosened and the machine screws turned in, which will draw the slide against the cross-slide V's. The nuts are then set up and the adjustment is complete.

If no slots are provided in the table-top for holding the work, holes may be drilled and tapped at convenient points for clamping the work. The boring-table is quickly applied by drawing off the regular tool-slide and pushing the other on, using the same feed screw. Besides holding work for boring or milling and drilling, the table can be used, as stated above, for holding a small grinding-wheel motor for cylindrical or face grinding of work held between centers, on the face-plate, or on special brackets attached to the lathe-bed.—H. H. PARKER.



Owners of small lathes will find this boring and milling table very useful in their work

ing-wheel, bolted to the table for special grinding work; but the holes would also accommodate clamp bolts for large work.

A pattern for this table is easily made, as there are no cores or loose pieces. If the builder does not wish to use a casting, the table could be made of a piece of heavy

Piping the Flow of a Spring

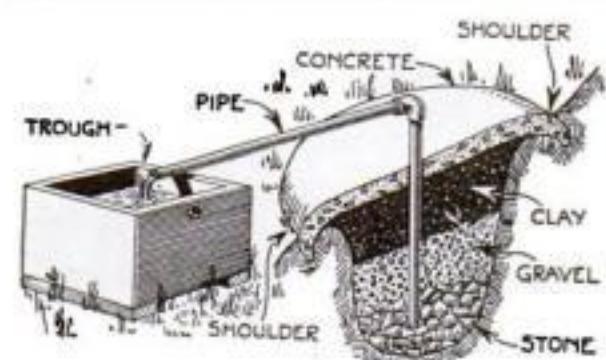
VERY often when a spring is located in a low place and used for stock drinking-places, the trampling of the stock will break in the sides of the spring and cause it to fill up and get swampy. It is possible to pipe a spring of this sort so that the water may be carried to a distant point and allowed to run into a watering-trough.

First it is necessary to clean out the spring location to a good size and without making the depth any greater than necessary, but trying to arrange the spring so that it will have good solid sides or walls.

Take a short length of pipe, about 1 in. in diameter, and set it upright in the center of the spring and at a short distance from the bottom, being careful to keep the water baled out as it enters. Fill around the bottom of the pipe with good sized clean stone and then over that with fine sand and gravel to within a few inches of the top of the basin. The work must be done quickly. Then pack over the top with thick clay that has been previously prepared, and ram and tamp down firmly all over the top of the spring location. This makes a top coating that will not allow the rising water to seep

through and later it can be covered with a layer of concrete to prevent rains from washing away the surface. The rising water can find an exit only through the pipe. Some experimenting may be necessary to find the correct height of pipe.

An elbow screwed to the upper end of the pipe and a length of drainpipe screwed into



If you have a spring on your land, you may improve it by collecting and piping the water as shown

the elbow is used to carry the water to the trough placed at a slightly lower level than the spring.—B. F. DASHIELL.

Larger Picture Puzzles Free



How Many Objects Beginning with "C" Can You Find in Picture?

Observe These Rules

1. Any person who is not an employee, or relative of any employee of the Minnesota Pen Co., may submit an answer. It costs nothing to try.

2. All answers must be mailed by December 24, 1921.

3. All answers should be written on one side of the paper only, and words numbered 1, 2, 3, etc. Write your full name and address on each page.

4. Only words found in the English dictionary will be counted. Do not use obsolete, hyphenated or compound words. Use either the singular or plural, but where the plural is used the singular cannot be counted, and vice versa.

5. Words of the same spelling can be used only once, even though used to designate different objects. An object can be named only once. However, any part of the object may also be named.

6. The answer having the largest and nearest correct list of names of visible objects shown in the picture that begin with the letter "C" will be awarded first prize, etc. Neatness, style or handwriting have no bearing upon deciding the winners.

7. Candidates may co-operate in answering the puzzle, but only one prize will be awarded to any one household; nor will prizes be awarded to more than one of any group outside of the family whose two or more have been working together.

8. In the event of ties, the full amount of the prize will be paid each tying contestant.

9. These well-known business men, having no connection with the Minnesota Pen Co., will judge the answers submitted and award the prizes. Participants agree to accept the decision of the judges as final and conclusive. The following men have agreed to act as judges of this unique competition:

W. H. Beavens, Cashier, Produce Exchange Bank; Paul J. E. Reiske, Principal, Franklin Public School, St. Paul; K. W. Husted, Civil Service Bureau, St. Paul.

10. All answers will receive the same consideration regardless of whether or not an order for a Minnesota Fountain Pen has been sent in.

11. The announcement of the prize winners and the correct list of words will be printed at the close of the contest and a copy mailed to each person purchasing a Minnesota Fountain Pen.

How to Win \$1,500.00

MINNESOTA

"The Easy-Writing Fountain Pen"

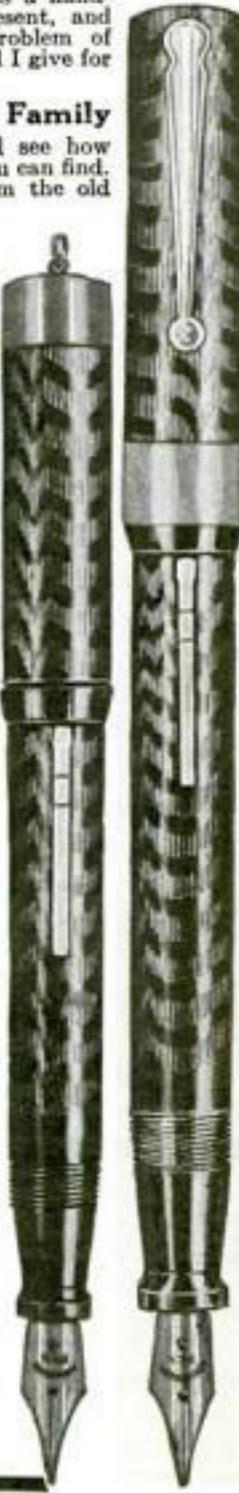
You will find the Minnesota one of the finest pens you ever used. The ink flows smoothly, and you can't resist the easy way in which it writes. Unless our pens were the very best that money can buy, we could not afford to advertise them the way we do. Thousands of them are now in use. Their popularity is increasing by leaps and bounds. If you need a good pen, or if you would like to make a useful and handsome gift to someone, the Minnesota is just what you have been looking for. The pen speaks for itself. We cannot tell you in words, what five minutes' use of the Minnesota will tell you.

Satisfied Users Everywhere

In New York, in Chicago, in Boston, in St. Louis, in San Francisco, and in fact in almost every town and on many a farm you will find the Minnesota Fountain Pen. The ink flow in the Minnesota is perfect. It does not blot or stain the fingers. Writing becomes a real pleasure when you use the Minnesota.

THE PRIZES

	If no pens are purchased	If one \$5 pen is purchased	If \$9.00 pens are purchased
1st Prize	\$20.00	\$500.00	\$1,500.00
2nd Prize	10.00	250.00	750.00
3rd Prize	5.00	125.00	375.00
4th Prize	5.00	75.00	187.50
5th Prize	5.00	50.00	100.00
6th Prize	3.00	25.00	75.00
7th Prize	3.00	20.00	50.00
8th Prize	3.00	15.00	40.00
9th Prize	2.00	15.00	30.00
10th to 15th	2.00	10.00	20.00



Money-Back Guarantee

We guarantee Minnesota Fountain Pens to be perfectly satisfactory. If you are not satisfied with it on arrival, return it and we will exchange it or refund your money.

MINNESOTA PEN CO.

Dept. 715

Saint Paul

Minnesota

WURLITZER
200 Years of Musical Instrument Making

Your Choice On Trial

WURLITZER will send you *any instrument* with complete outfit for a week's Free Trial in your own home. No obligation to buy. Return the instrument at our expense at the end of the week, if you decide not to keep it. Trial won't cost you a penny.

Monthly Payments

A few cents a day will pay for instrument and complete outfit.

Complete Outfit

You get with the instrument everything that you need—velvet and plush lined carrying case with lock and key, all accessories, extra parts, self instructor, music, etc.—all at direct cost, practically for the cost of instrument alone.

Wurlitzer has made the finest musical instruments more than 200 years.

All instruments including Pianos and Victrolas, are embraced in the Wurlitzer plan.

Send for New Music Book, No Charge

Every known instrument illustrated with prices, monthly payments and free trial blank. Book is absolutely free. Send the coupon now.

The Rudolph Wurlitzer Co.
Cincinnati, Ohio
Chicago, Ill. New York, N.Y.

THE RUDOLPH WURLITZER CO.
Dent 1783 117 East 4th Street, Cincinnati, Ohio
700 Jackson Blvd., Chicago, Ill.; 120 W. 42nd St., New York, N.Y.
Send me your new catalog with illustrations in color and full description of the Wurlitzer Complete Outfits and details of the free trial and easy payment offer.

Name.....

Address.....

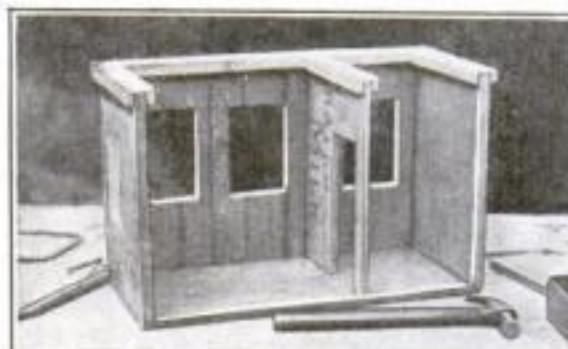
State musical instrument in which you're especially interested

Copyright 1921, The Rudolph Wurlitzer Co.

THE HOME WORKSHOP

How to Make and Furnish a Doll's House

By E. Bade



Make the framework of the doll's house from parts of an old box, and saw doors and windows to suit

EVERY boy who has a younger sister can make for her a doll's house from an old box and some odds and ends of wallpaper. Any strong box about 2½ in. long, 1 ft. deep, and 1 ft. high, can be used. One side is carefully taken out and all projecting nails removed.

Three squares, which form windows, are cut out from the back of the box, and a partition, with a large rectangle sawed out to represent the door, is nailed to the box, which now consists of two rooms—the dining-room and the bedroom. A door is



An open fireplace lined with brick-paper may be made and provided with a mantelshelf

made that must fit into the rectangular opening. This is later nailed to the partition with two small brass hinges so that it can be opened. Cornices are nailed around the top of the box. This gives the finished house a realistic appearance.

Brick or wood paper is glued to the outside of both sides and the back of the box, while the inside is finished with odd pieces of wallpaper. The windows are fitted with glass and small strips of wood represent theills.

The furniture for this doll's house may be made of cigar-box wood. The tools required consist of a knife, a hammer, and some small nails. Paint or stain can also be used, although this is not absolutely necessary.

Chairs, beds, and benches are made from strips of cigar-box wood. These should be



Brick-paper is pasted on the outside of the house and the windows are provided with frames

about $\frac{3}{8}$ in. wide, and as thick as the wood. It is best to cut the wood with the grain. This will make the strips as long as the box. They are cut into suitable lengths for the legs, sides, and seats of the different pieces of furniture.

To make a chair, cut two $3\frac{1}{2}$ -in. pieces for the back legs, and six $1\frac{1}{2}$ -in. strips for the seat and the braces, and two other $1\frac{1}{2}$ -in. pieces for the back rest. Arm-



With a little patience a complete set of furniture for the doll's house may be made of cigar-box wood

chairs, Morris chairs, and rocking-chairs are similarly made. The same method is employed when making the bedroom furniture.

A dining-room table is made from an empty spool, preferably a large one, upon which a 3-in. square of cigar-box wood is nailed. If the table should not be high enough, two or three thicknesses of wood can be nailed under the spool. These will represent the feet of the table.

An open fireplace can also be made of a small box about 3 in. square with one side removed. Slanting sides are nailed to the



The arrangement of the interior and the addition of ornaments may be left to the taste of the owner

box to represent the chimney. About $\frac{1}{4}$ in. above the box, one of the strips made for the furniture is nailed around it. This will give the appearance of a mantel. To heighten the effect brick-paper is glued to the wood.

"Every-Day Wonders"

Beginning with this issue, POPULAR SCIENCE MONTHLY will publish each month ten questions on general science that affect your daily life. To know and understand the answers means that you have laid the foundation for a sound education. The questions will be found in this number on page 32. The answers are printed on the same page.

THE "HOME" WORKSHOP

Wood Puzzles that Will Interest Your Friends

FIGURE 1 shows a piece of wood with a round, a square, and a triangular hole in it. The puzzle is to cut one piece of wood that will exactly fit the three holes.

To do this, get a cylindrical piece of wood that will exactly fit the round hole in Fig. 2. From this cylindrical stick cut off a length equal to its diameter. If put in sideways, it will fit the square hole. Now draw a line through the center of the circle across one end and from the circumference

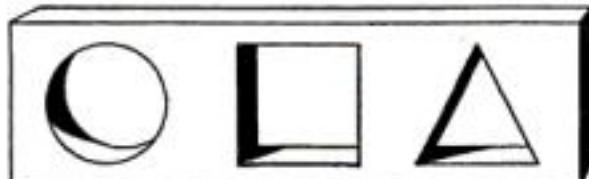
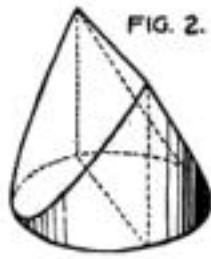


FIG. 2.

FIG. 1.



The peg to the left will fit a round, a square, and a triangular hole

of the other end cut a bevel to this line. The plug will then fit each hole.

Figure 3 is the mysterious dovetail. It seems impossible to make, as the mortises apparently run through each other from each side. Figure 4 shows how it is made. Join two square-cornered pieces of wood neatly and carefully by two mortises. Then chisel the corners off to the dotted line, leaving another square block as shown in Fig. 3.

Figure 5 is one piece of wood passed through another, which just fits the stem,



FIG. 3.



FIG. 4.

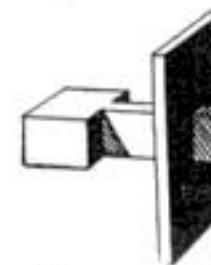


FIG. 5

FIG. 6.

The construction of two puzzles that can be cut from a block of wood

or narrow part, and has no joint. It may be made either by choosing soft wood and soaking it in boiling water until compressible, or, better, by making two pieces like Fig. 6, and gluing them together. The joints, being at the corners, should be quite invisible.—E. A. McCANN.

Do You Know How to Make a Glue-Joint Invisible

WHEN making a glue joint, always, if possible, lightly sandpaper the joint before the glue dries. This will fill up any slight crack with fine sawdust and greatly aid in hiding the joint.—E. A. McCANN.

**Democracy**

"—of the people, by the people, for the people"

People of every walk of life, in every state in the Union, are represented in the ownership of the Bell Telephone System. People from every class of telephone users, members of every trade, profession and business, as well as thousands of trust funds, are partners in this greatest investment democracy which is made up of the more than 175,000 stockholders of the American Telephone and Telegraph Company.

If this great body of people clasped hands they would form a line more than 150 miles long. Marching by your door, it would take more than 48 hours of ceaseless tramping for the line to pass.

This democracy of Bell telephone owners is greater in number than the entire population of one of our states; and more than half of its owners are women.

There is one Bell telephone shareholder for every 34 telephone subscribers. No other great industry has so democratic a distribution of its shares; no other industry is so completely owned by the people it serves. In the truest sense, the Bell System is an organization "of the people, by the people, for the people."

It is, therefore, not surprising that the Bell System gives the best and cheapest telephone service to be found anywhere in the world.

BELL SYSTEM**AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES**

One Policy, One System, Universal Service, and all directed toward Better Service

**Aviation principles quickly learned by building models****START BUILDING your own MODEL AIRPLANES**

Aeronautics offers the biggest and best field in the world for ambitious young men. Valuable education and fascinating sport. Our new full size planes show you a side, top and front view of the complete model aeroplane. Numerous sketches and details show exactly how to cut and fit each part and make it easy for you to build and fly these accurate miniatures of famous aeroplanes.

NOW READY LOARING RACING MONOPLANE

E. E. V. SCOUT BIPLANE
The most complete and easiest understood model plans ever presented, on sheets 24 inches by 36 inches, either set sent postpaid for \$1.00. State which you want!

Send 25 cent stamp and address of three interested friends for our new price list of guaranteed model aeroplanes and supplies.

W. H. PHIPPS CO., Aero. Dept., Baldwin, Long Island, N. Y.
(Guaranteed as represented or money refunded.)

FREE PROFESSIONAL TONE MUSICAL INSTRUMENTS

and lessons sent on free trial. Violin, Tenor Banjo, Hawaiian Guitar, Ukulele, Mandolin, Corno, Banjo Mandolin, Banjo Ukulele, Guitar, Banjo Guitar, or Banjo. Wonderful new copyrighted system of teaching note music by mail. Four lessons will teach you several pieces. Over 100,000 successful players. Do not miss this free trial offer. Write for booklet. No obligations.

SLINGERLAND SCHOOL OF MUSIC, Inc.,
1815 Orchard Street, Dept. 135, Chicago, Illinois

Standard Underwoods**5-Year Guarantee**

Yes, this genuine Standard Visible Writing Underwood newly rebuilt, at much less than factory price, yours for \$3.00 down and then easy monthly payments.

10 Days' FREE Trial
Try it for 10 days at our risk.

Money-back guarantee. Send now for free book big bargain offer.

**TYPEWRITER EMPORIUM, 2149 Shipman Building
SHIPMAN-WARD MFG. CO. Chicago, Illinois**



The Letter That Saved Bob Johnson's Job

—and paved the way to a better one!

IT was written to his employer by the International Correspondence Schools. It told how "Robert Johnson had enrolled for a course of home-study and had received a mark of 94 for his first lesson."

Bob answered the summons to the Chief's office with just a little fear and trembling, for a lot of men were being dropped—a lot more were having their pay reduced.

But as Bob came in, his employer did a surprising thing. He got up quickly from his desk and grasped Bob warmly by the hand.

"I want to congratulate you, young man, on the marks you are making with the I. C. S. I am glad to see that you are training yourself not only for your present job but for the job ahead.

"We're cutting the pay-roll. Until I received this letter, I had you in mind as one of the men to be dropped. But not now. Keep on studying—keep your eyes open—and pretty soon there'll be a better job for you around here. We're always looking for trained men."

Won't you let the I. C. S. help you, too? Won't you trade a few hours of your spare time for a good job, a good salary and the comforts that go with it? Then mark the work you like best on the coupon below and mail it to Scranton today. That doesn't obligate you in the least, but it will be your first big step towards success. *Do it now!*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7647-B SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

- | | |
|--|--|
| <input type="checkbox"/> ELECTRICAL ENGINEER | <input type="checkbox"/> CHEMICAL ENGINEER |
| Electrician | Pharmacy |
| <input type="checkbox"/> ELECTRIC WIRING | SALESMANSHIP |
| Electric Lighting | ADVERTISING MAN |
| Electric Car Running | Window Trimmer |
| Heavy Electric Traction | Show Card and Sign Painter |
| Electrical Draftsman | RAILROAD POSITIONS |
| Electric Machine Designer | ILLUSTRATOR |
| Telegraph Expert | DESIGNER |
| Practical Telephony | BUSINESS MANAGEMENT |
| <input type="checkbox"/> MECHANICAL ENGINEER | Private Secretary |
| Mechanical Draftsman | Business Correspondent |
| Ship Draftsman | BOOKKEEPER |
| Machine Shop Practice | Stenographer and Typist |
| Toolmaker | Cert. Pub. Accountant |
| Gas Engineer | Traffic Management |
| CIVIL ENGINEER | Commercial Law |
| Surveying and Mapping | GOOD ENGLISH |
| MINE FOREMAN OR ENGINEER | STATIONARY ENGINEER |
| ARCHITECT | CIVIL SERVICE |
| Architectural Draftsman | Railway Mail Clerk |
| PLUMBING AND HEATING | Textile Overseer or Sup't. |
| Sheet Metal Worker | AGRICULTURE |
| Navigator | Poultry Raising |
| | Automobiles |
| | Spanish Banking |

Name _____
Present Occupation _____
Street and No. _____
7-1-21

City _____ State _____
Canadians may send this coupon to International Correspondence Schools Canadian, Limited, Montreal, Canada



The Burlington 21 Jewels

See it first. We send it for you to look at and examine carefully. You are under no obligation to buy. A 21-jewel watch sold to you at a price a great deal lower than that of other high grade watches.

\$500 a month

The 21-Jewel Burlington is sold to you at a very low price and on the very special terms (after free examination) of only \$5.00 a month—no interest. Send for full information. **Free Book** Send for the most complete watch book ever produced, 100 designs and engravings beautifully illustrated in colors. Write for it today! It is free. A letter or post card will do.

Burlington Watch Company, Dept. 1369
19th Street and Marshall Blvd., Chicago, Illinois
Canadian Office: 62 Albert St., Winnipeg

THE HOME WORKSHOP

To Prevent Breaking a Small Drill

By Albert Strandin
First Prize, "Best Idea" Contest, December

Your fingertips will tell you how to feed the drill without breaking it

TO drill a hole with a small drill in a piece that is chucked in an engine lathe, without breaking the drill requires great skill and patience. The least bit of excessive pressure applied to the hand wheel will result in a broken drill and many times in a spoiled job.

To eliminate this trouble, the writer evolved a simple scheme that works very satisfactorily.

By removing the hand wheel on the tailstock shaft and tightening the nuts in place, as shown in the picture, the worker, by the use of his thumb and forefinger, can obtain a very sensitive touch for feeding the drill, which otherwise would not be possible.

This Boiler-Baker Is a Boon to Housewives

By Roland B. Cutler
Second Prize, "Best Idea" Contest, December

AN excellent oven for the oil- or gas-stove can be made from an old wash-boiler and a length of stove-pipe, heavy tin, or galvanized iron.

Centered on one side of the boiler, mark out a 9 in. by 12 in. space; the 9-in. width beginning about 2 in. from the top and bottom if the utensil is standard. In the center of this space cut out opposite flaps each 4 in. wide, and bend them up 2 in. and over at right angles to form supports for the oven bottom. Cut each side flap far enough so that when it is bent back and up 2 in., the supports will be about where the curve commences, as shown. This cut-back will probably be 4 in.

Cut the bottom 10 in. wide and with the ends bent over 1 in. to fit over the supports. Cut each side to fit in the boiler with one end bent 1 in. at right angles. Slit each corner of the tops far enough to bend down and out 1 in. midway of the oven on which a second bottom or shelf can rest.

Make this out of heavy wire doubled

back and forth to the right width, and fasten at the ends with lengths of tin 2 in. wide, doubled over and riveted between the wires as shown. Punch a $\frac{1}{4}$ -in. hole in each end of the boiler, 2 in. above the oven-bottom level for ventilation.

The handy man may construct this baking-oven from an old wash-boiler

\$75 in Prizes Each Month for the Best New Ideas

AFIRST prize of \$50 and a second prize of \$25 will be awarded every month to the authors of the two best articles appearing in this department. Every article submitted will be considered as a possible prize-winner. Those which do not win prizes may be purchased at space rates. The prizes will be awarded upon publication and checks will be mailed to the winners during the same month.

Prize-winning articles may be long—but not over 1000 words—or they may be very short. The idea, device, or machine described must be practical and ingenious; it must fill an actual need in the home, office, or shop.

This contest must not be confused with other contests which Popular Science Monthly is conducting at this time.

Prize-Winners for December

The two prizes of \$50 and \$25 for the "Best Ideas" appearing in the December issue of Popular Science Monthly have been awarded respectively to Albert Strandin, Chicago, Ill., and Roland B. Cutler, Springfield, Vt. These two ideas were considered by the judges to possess the highest all-round merit.

It should be remembered that this "Best Idea" contest is a monthly feature. You may have an idea that will win the prize next month. Read the rules above.

Copyrighted material

Improved Spur for Stump-Boring Auger



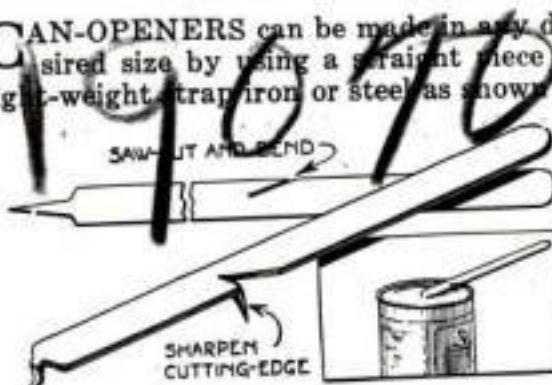
This method of changing the spur of the auger makes it efficient

to the cutting lips. Such an edge will allow of cutting down into the roots.

When a rounded spur auger is used the rounded form of the spur will tend to force the auger out of the wood, while it is almost impossible to cut small, brown roots. If you take a file and cut the spur to the shape shown the edge, being at right angles to the line of cut, will sever all wood and roots with ease.

Can-Opener Easily Made from Strap Iron

CAN-OPENERS can be made in any desired size by using a straight piece of light-weight trap iron or steel as shown in



This can-opener, made from a piece of strap steel, will be found effective for cans of one size

the drawing. One end is pointed and a cut is made in the piece at an angle. The end and the cut are bent as shown. The cutting edge must be sharpened.

Here Is a Use for a Discarded Gasoline Barrel

WITH a little work, a gasoline barrel may be turned into a refuse- or waste-burner.

The top of the tank should be removed with a hatchet or tin snips. A small door should also be cut in the side of the tank next to the bottom, to be used as a draft door. Then a stand made of strong strap iron, which is easily procured should be placed in the bottom of the tank. A wire screen resting on this stand will serve as a grate. When waste is ignited in the tank, it will burn rapidly and with safety from sparks.



A waste-burner for the back yard



CLASS PINS

FREE CATALOG LIVE NAME OF SCHOOL OR
CLUB AND NUMBER IN CLASS.
Either pin illustrated made with any 3 letters
and 2 figures, one or two colors enamel. Silver
plate, \$15.00 ea., \$2.50 doz. Sterling silver, \$20.00
ea., \$5.00 doz. Write for new catalog.
BASTIAN BROS., CO.

One Man Saw Rig

Cuts Faster—Pays for Itself
Save your own wood for winter. Make big
money cutting wood for market. New OT-
TAWA One-Man Saw Big saves time and labor.
It's named Mac-Moto compassed. No extras to buy.



AUTO OWNERS

Save half of your tire cost by using Double-Mileage, Double-Tread Tires, Guaranteed 6000 Miles. We lead, others try to follow. They are reconstructed of highest grade material — hardly ever blow out. They are only guaranteed for 6000 miles, but have run from 8000 to 10,000 miles. Order today at these low prices:

these low prices:		
Size	Tires	Wheels
30x2	\$5.50	\$1.60
30x3	6.50	1.75
31x3½	6.75	1.82
32x3½	7.00	2.00
31x4	8.00	2.25
32x4	8.25	2.40
33x4	8.50	2.50
34x4	8.75	2.65
35x4½	10.00	3.00
36x4½	11.00	3.10
36x4¾	11.50	3.25
37x5	12.25	3.40

RELINER FREE WITH EVERY TIRE
Send \$2.00 deposit with each tire ordered, balance
C. O. D. Tires shipped subject to your examination. State
whether S. S. or C. plain or non-skid is desired. All same
price. By sending full amount with order you can save
on special cash-with-order discount.

DOUBLE MILEAGE TIRE & RUBBER CO.
2035 W. Harrison, Dept. 102, CHICAGO, ILL.

The Strength and Charm of Physical Perfection!

Learn the Secret
FREE!



Learn of the tremendous curative power—the manifold uses of VI-REX Violet Rays in treating almost every known human ailment—Nikola Tesla's great discovery! This book also contains charts and diagrams of the nervous system and organic locations, and fully describes just how the Vi-Rex Violet Ray works its many miracles. Written in a simple style—devoid of all technical language.

Vi-Rex Rays

Assure for You Amazing
Health and Vitality

Enjoy Wonderful Sparkling Health! Increase your store of energy, revitalize your worn-out cells, make every fibre of your body tingle with a new vim and vigor! All this you can have through the magic of Vi-Rex Violet Rays—right in your own home!

Violet Rays penetrate to every cell in the body, imparting that stimulating vigor which brings the glow of health, tones up the entire system, putting life into overtaxed and sluggish tissues. As a quick relief from pain, Vi-Rex has no equal. Headaches, nervousness, skin blemishes, and many other complaints vanish as if by magic through this marvelous treatment.



Try the Wonders of Vi-Rex Violet Rays

10 Days FREE

Find out how Violet Rays will help you! Demonstrate for yourself. Read what hundreds of users say about the VI-REX and the astonishing results which have been obtained. Learn why it is the most economical and practical machine of its kind available. There is no limit to its beneficial powers. Just mail the coupon or send a postal. Do it NOW!

VI-REX ELECTRIC CO., Dept. 1512
326 West Madison Street, Chicago

Please send me, without any cost or obligation, your free book describing your Violet Ray Machine, and details of your free trial offer.

Name.....

Address.....

City..... State.....

THE HOME WORKSHOP

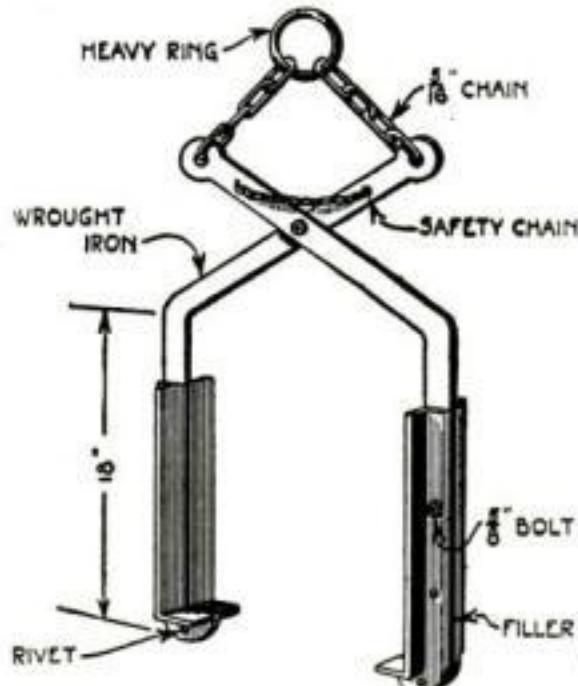
To Lift Locomotive Driving Boxes Vertically

THE width of the device shown here can be made as desired, to suit the size of the box or of a size that will average reasonably close for boxes close to the range of the lifter.

The tong part is made of $\frac{3}{8}$ in. by 2 in. iron, while the lifting hooks are of $\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by $2\frac{1}{2}$ in. angle-iron. The tongs extend down only to about the middle of the lifting pieces. These are fastened to the tongs by $\frac{1}{2}$ -in. bolts on which the lifter can swing. Below the tong part a $\frac{3}{8}$ -in. filler is provided, which is riveted to the angles.

A $\frac{3}{8}$ -in. bolt is provided as a pinion for the tongs. Fastened or linked on to the lifting-ring, $\frac{5}{16}$ -in. chains are used. You will note the action, that in lifting, the pull on the chains transmitted to the tongs tends to close them on the box.

Another very good feature is the safety chain, which is fastened by an eyebolt at one end and goes over a hook at the other. Hence, when the device is placed on a



Lifting-tongs of this type are very useful in shops where heavy loads of square forms must be lifted

driving-box, an accident through the opening of the device is almost impossible.

This device is well-nigh indispensable for placing driving-boxes on axles of locomotives and can also be used in lifting off boxes to be repaired.—L. J. BITNER.

Wheelbarrow Wheels Can Be Built at Home

I MADE a fairly good wheel in the following manner: Two circular disks were sawn from a 1 in. by 14 in. plank, the full width of the board. A $\frac{3}{8}$ -in. hole was then bored in each and the two pieces were nailed together, crossing the grain of the wood, and using sixpenny finishing nails. Nails were driven into the disks about $1\frac{1}{2}$ in. apart from each side and the nails were clinched. Two 1 in. by 6 in. blocks, with the corners sawed off and each block chamfered on one side and $\frac{3}{8}$ -in. holes bored through their centers, were then nailed to the wheel—one on each side—with the grain of the blocks crossing the grain of the piece to which it was nailed. These pieces also were shower nailed.

A $\frac{3}{8}$ by $3\frac{1}{2}$ in. common pipe-nipple and $\frac{7}{16}$ by 10 in. bolt and nut and four $\frac{1}{2}$ -in. cut washers completed the axle assembly.

The $\frac{3}{8}$ -in. nipple was driven into the hole in the center of the wheel, about $\frac{1}{4}$ in. protruding on each side. The frame of the barrow was made so as to allow for a washer at each end of the nipple, or hub, of the wheel, and a washer under the head of the bolt and under the nut.

In giving the length of the pipe-nipple for the hub, or thimble, and the length of the bolt which is to be used for the axle, it must be remembered that these

lengths are for dressed lumber, which is only $13/16$ in. thick; thus the four pieces when assembled will measure $3\frac{1}{4}$ in.

However, if necessary to use undressed lumber, be sure that both the nipple and the bolt are long enough. Remember, also, that

pipe-nipples are measured inside, and, further, they are all oversize; hence you cannot use a $\frac{3}{8}$ -in. bolt for the axle—the wheel would wobble too much. There is little likelihood of the nipple ever coming loose if it is driven tightly into the wheel.

A wheel made in this manner will not only have very little wobble, but it will last for years; and it is inexpensive.

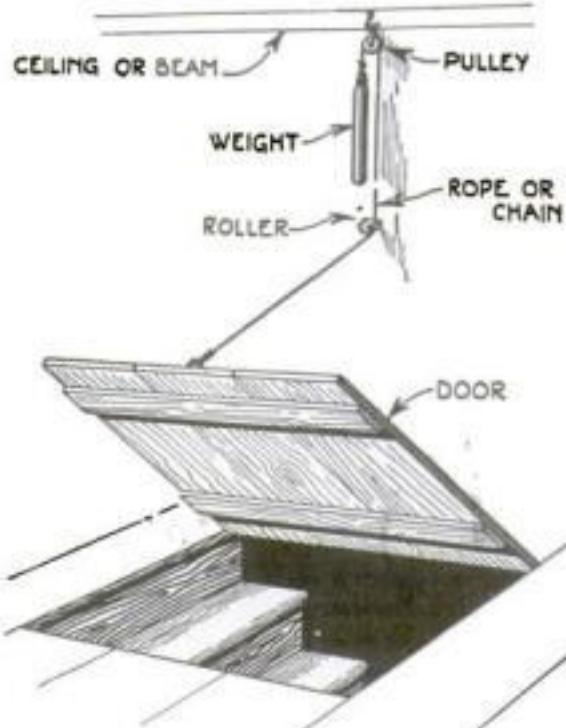


This wheel can easily be made by the amateur carpenter

A Weight to Aid in Lifting Heavy Doors

A RESTAURANT I visit has a large icebox with heavy lift door. It is necessary for the waiters to raise this door many times.

The ingenious proprietor placed a strong window-weight cord with weight attached over a pulley in the ceiling above the box, then attached the other end of the cord to the front of the icebox door. The weight is not quite so heavy as the door, but it helps materially, and the appliance is so



Provide your cellar trapdoor with a counterweight and you will be able to raise it much easier

arranged that the door stays open in a vertical position after being raised, allowing the waiter to use both hands in removing things from the chest.—A. W. ROE.

THE HOME WORKSHOP

Shoe-Polishing Rendered Easy with a Support

DON'T polish your shoes on a chair or other furniture. Make a shoe-polishing stand. It takes up no room, does not disfigure the wall, is very useful, and is easy to make.

All that is necessary for such a device are a few pieces of wood, a bolt, and a number of screws of different sizes, a saw, a plane, and a screwdriver.

First, two pieces of wood are cut alike, and planed down. These are the supports of the footrest. These two pieces should be made of stout material so that

they will not break by the strain to which they are subjected. The crosspiece holding the foot-rest should also be made from a stout piece of wood, and must be tapered. The end protecting outward from between the two supports can be made as thin as desired, although it should be at least $\frac{1}{2}$ in.

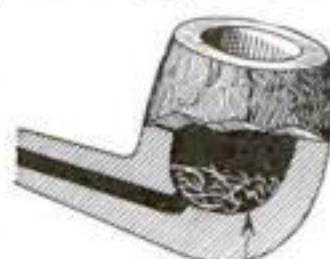
in thickness. The other end, especially that part which lies between the supports, should be quite wide. When this piece has been cut, the footrest, which may consist of a thinner piece of wood, should be attached to the crosspiece.

The bolt is passed through the two supports and through the cross piece. Then

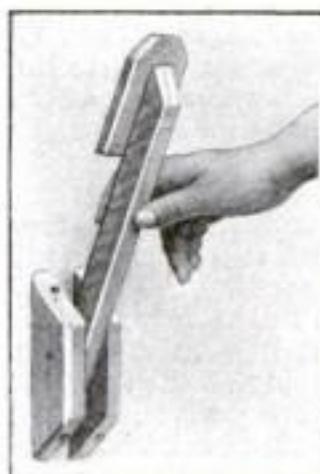
the supports can be attached to the wall at any convenient place about 1 ft. above the floor. When the stand is to be used, it is simply let down so that it stands horizontally. When out of use, it is lifted and rests flush with the wall.

If Your Pipe Fails to Draw, Try This

BEFORE loading the pipe with tobacco, place a small piece of steel wool in the bottom of the bowl, and press it down with the finger. Then the tobacco may be filled in. By doing this, you not only get an easier draft in your pipe, but it prevents the pipe from becoming clogged with small bits of tobacco. The steel wool also stops the nicotine from going through the pipe and may be changed whenever necessary.



STEEL WOOL
Steel wool in the bowl keeps the tobacco out of the stem



When not in use,
the foot-rest folds
against the wall



The rest is turned
down when required
for polishing shoes

**Hanes 5 Big Features**

(Shirts and Drawers)

- 1 HANES STANCH ELASTIC SHOULDERS made with service-doubling lap seam. They fit right, with lots of give for every motion.
- 2 HANES ELASTIC KNIT COLLAR is flat and snug. Keeps cold winds out and holds its shape.
- 3 HANES ELASTIC CUFFS are made far stronger and better than the usual cuff. They fit the wrists firmly; they won't flare and won't rip from the sleeve.
- 4 HANES 3-BUTTON SATIN WAISTBAND means real comfort-fit in drawers. Made of sturdy sateen, double-sewed, long wear is sure.
- 5 EXTRA GUSSET IN LEGS assuring better fit and longer service. You'll appreciate the extra comfort.

**GUARANTEED VALUE—
that's the word behind
HANES Underwear**

Hanes Winter Underwear comes to you at the lowest prices in years—with the assurance that it will give long wear—or you get your money back! *That promise is the Hanes guarantee!*

We know Hanes Underwear! We know what wear and comfort you'll get from those Hanes features shown in the illustration.

Every operation in the manufacture of Hanes Underwear—spinning the yarn, knitting, cutting and tailoring, are done according to Hanes standards—standards that have made Hanes the most popular men's underwear in America!

See the Hanes line at your dealer's! And remember—there have been tremendous reductions in Hanes prices. There's the *longest measure in value* in those heavyweight union suits, and shirts and drawers. You can see that with half an eye! And the mediumweight silk-trimmed union suit has won the admiration of thousands of extra warm-blooded men and indoor workers.

Union Suits for Boys—Made in two weights, medium and extra heavy—in sizes from 2 to 16 years. Two to 4 year sizes have drop seat.

Always look for the Hanes label when you buy.

If your dealer can't supply you with Hanes, write us immediately.

Hanes Guarantee

We guarantee Hanes Underwear absolutely—every thread, stitch and button. We guarantee to return your money or give you a new garment if any seam breaks.

P. H. HANES
KNITTING COMPANY
Winston-Salem, N. C.

Next Summer You'll want to wear Hanes Nainsook Union Suit!

AUTOMOBILE REPAIRING MADE EASY

By Victor W. Page. A thoroughly practical book containing complete directions for making repairs to all parts of the motor car mechanism.

1,050 pp. Price, \$4.00

POPULAR SCIENCE MONTHLY, 225 West 39th St., New York

MURDER WILL OUT

Police departments, factories, banks and industries everywhere are adopting the finger print method of identification to locate criminals.

Be a Finger Print Expert

You can train yourself at home in spare time. Write for FREE reports telling of the uses of finger prints and how you can learn this profitable profession. Positions Guaranteed.

U. S. SCHOOL OF FINGER PRINTS
Room 1049 7003 No. Clark St. Chicago, Ill.



We'll teach you by mail in few weeks, to oil paint beautiful Portraits, Landscapes, and start a Tanglewood Studio at home. Instruct you to manage same, furnish outfit and materials. No experience needed. Booklet free. TANGLEWOOD CO., 136 Main, Muscatine, Iowa.

BUILDING AND FLYING AN AEROPLANE

By CHARLES B. HAYWARD. A practical handbook covering the design, construction and operation of aeroplanes and gliders. 150 pages. Price, \$1.50.

Popular Science Monthly, 225 West 39th Street, New York

Learn to Dance

I CAN TEACH YOU Fox-Trot, One-Step, Two-Step, Waltz and newest "up-to-the-minute" society dances in a few hours—at home—in private by the wonderful

Peak System of Mail Instruction

REMARKABLE NEW METHOD. Easy—fascinating.

RESULTS GUARANTEED. No music—no partner needed. Thousands taught successfully.

COMPLETE COURSE ON TRIAL. Write me today.

FREE Information and Low Surprise Offer.

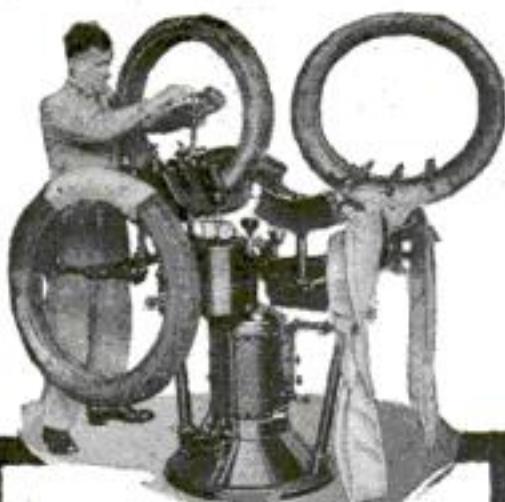
WILLIAM CHANDLER PEAK, M.B.

Studio 48 4737 Broadway Chicago, Ill.

**REAR FENDER BRACE FOR FORDS**

Stop the squeak and rattle in your rear fenders with Dunn Braces. Prevent breakage. They look well. Only \$1.00 per pair, at your dealers, or mailed prepaid for that amount. Easily installed yourself. End your fender trouble. Send name and \$1.00 now. Shipped day order received.

DUNN MFG. CO., 707 Main St., Clarinda, Ia.



\$6000.00 YEAR WITH THIS MACHINE

WHAT others have done, YOU CAN DO! \$6,000.00 year is low estimate. Many make more. This new machine and Haywood's Tire Surgery method marvelous. Starts you in paying business quickly. No experience needed. Taught at my school or by mail within two weeks. Very little capital required. It's a bonanza for ambitious men.

Many Men Making Money

Are you one of the crowd drifting back to 1914 wage scales? Protect yourself! Join the ranks of those who have forsaken jobs, time clocks and bosses! Be among these money makers! Hargan, of Ill., did \$20,000.00 last year. Fetzer Bros., Pa., made clear net profit of \$3,500.00 during first year. Spring City Tire Co., Wis., did about \$26,000.00 to date, and expect year's total to reach \$50,000.00. Ramsey, S. D., working alone, cleared \$441.56 in one month. Wendt, Ind., approximates \$500.00 month. Tucker, Ill., runs high as \$127.00 weekly single handed. Mitchell, Ill., says "Record day was \$360.00—last month did \$2,600.00." And so on!

Great Opportunity Now

Above successes were made within past eighteen months. These men took advantage of splendid conditions. Right now car owners are economizing. Not buying new tires. Making old ones do. This work flooding Tire Surgery stations with cash business.

Get My Big Proposition

Start like others have done. Get the facts. There's nothing to stop you. I'll help you to the limit. My proposition is highly interesting. My machine is marvelous. Its compact design and size make small, handy shop possible. Its big capacity earns money fast. Send this coupon or postal to me, personally. Write me tonight.

M. Haywood, President

HAYWOOD TIRE & EQUIPMENT CO.
1161 Capitol Ave., Indianapolis, Ind.

Mr. M. Haywood, Pres.
Haywood Tire & Equipment Co.,
1161 Capitol Ave., Indianapolis, Ind.
Dear Sir: I am interested in Tire Surgery. Please
tell me all about this profitable business.

Name _____
Address _____

Dollars in Hares

We pay \$7.00 to \$18.50 and up a pair and express charges. **Big Profits.** We furnish guaranteed high grade stock and buy all you raise. Use backyard, barn, cellar, attic. Contract and Illustrated Catalog Free.

STANDARD FOOD AND FUR ASSN.
407C Broadway New York



MAKE MONEY AT HOME

YOU can earn from \$1 to \$2 an hour in your spare time writing show cards. Quickly and easily learned by our new simple method. No canvassing or soliciting, we teach you how, sell your work and pay you cash each week. Full particulars and booklet free.

AMERICAN SHOW CARD SCHOOL
206 Ryrie Building, Yonge & Shuter Streets, Toronto, Canada

THE HOME WORKSHOP

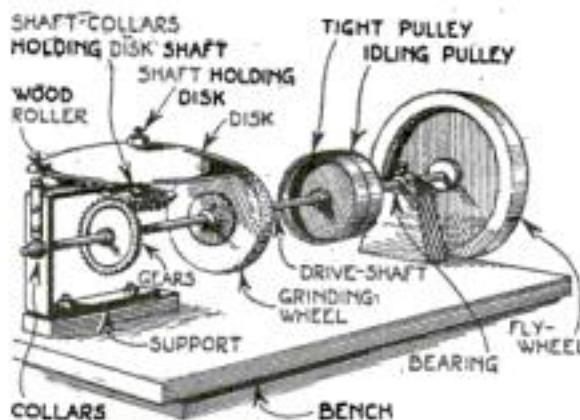
You Can Make this Disk-Grinder Yourself

By L. M. Jordan

OUTLINED in the illustration is a disk-grinder that is simple in construction and operation and grinds the disks automatically.

Procure a piece of 1-in. shafting, 6 ft. long. This shaft is mounted in a box bearing near one end on a mounting attached to a bench as shown, and the other end passes through a 1-in. hole in the center of a piece of malleable iron 1 in. thick, 3 in. wide, and 3½ ft. long, bent into the shape of the letter U. This iron lies on a block mounting on the bench, which is lower than that supporting the box bearing at the opposite end.

The lower side of this U-shaped stud is fastened to the block support and the bench with two heavy bolts drawn tightly. Through another hole in this stud extends a short piece of the same size shafting 10 in.



With a little skill and few tools you can make an automatic disk-grinder

long, 2 in. of the upper end of which are threaded for a retention nut. This short shaft is held at the proper height by two shaft collars. On the lower end of this shaft is mounted an 8-in. gear in an inverted position, beveled for right-angle

driving. This gear is engaged by a similar 6-in. gear mounted on the drive-shaft as shown.

A small wooden roller is mounted on the U-shaped stud in brackets made of strap-iron and riveted to the stud. This roller holds up one side of the disk level and the opposite side rests on the top face of a 3-in. emery-wheel mounted on the drive-shaft under the disk as shown. An inch of the short vertical shaft immediately under the threads is squared to fit the square hole in the disks. The disks are put on this shaft in an inverted position and a nut is screwed on to prevent them from coming off the shaft during the grinding.

The drive-shaft is prevented from playing back and forth in its bearings by two shaft collars, one on either side of the disk support piece or U-shaped stud. The hole in which the shaft rests in this piece is its bearing at this end, and should be kept well oiled.

Near the box-bearing mounting two small pulleys are mounted on the drive-shaft. One idles on the shaft and the other is fastened and drives it, with a small belt from the engine or countershaft. This allows shifting of the belt from driving pulley to idler when necessary to change disks.

A flywheel is mounted on the end of the shaft to balance the motion and power of the grinder. The disk rotates at lesser speed than the emery-wheel and in an opposite direction. A small wooden roller supports one side of the disk, while its other side rests on the face of the emery-wheel. On account of the ratio of the driving-gears the disk does not rotate as fast as the grinder, yet fast enough to keep it cool and grind it evenly and uniformly. Many disks can be sharpened in a day with this apparatus.

A Capacious Fountain for the Poultry

A POULTRY fountain that will hold enough water for a large flock may be made from a square 5-gal. oilcan such as is used for automobile oil and of which the spout and the screw-cap were melted off.

A strip 1 in. wide and the full width of one side of the can is cut and the can cleaned inside by scalding it with lye or washing it with gasoline. This strip is cut ½ in. from the edge or bottom of the can to leave a surface to which to solder. This surface is cleaned and scraped or sanded, so solder will adhere. A strip of tin 2 in. wide is now cut 6 in. longer than the exterior width of the can and the ends are bent so it will just straddle the can.

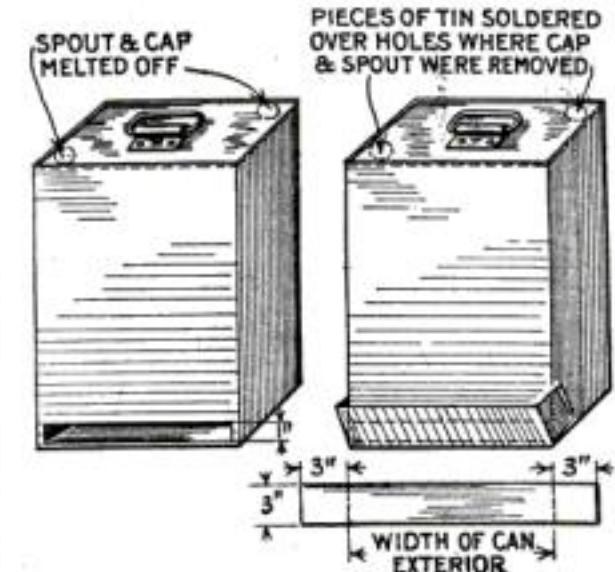
Clean this strip along one edge on both sides of the piece and both ends likewise so the solder will stick. Now lay the strip over the hole in the can with its clean edge along the bottom of the can and solder along the edge.

Then pull the top edge away from the can about 1¼ in. and clean the sides of the can where the ends of the strip will be soldered and solder the ends watertight.

Cut out pieces of tin large enough to cover the holes where the spout and cap were attached to the top of the can, clean the pieces and the can and solder airtight.

Lay the can on its side opposite this opening and pour in water until it is full, then set it up.

If raised from the ground by setting it on the inverted half of another can of like size, with small ventilating holes in it near the bottom, a brooder-lamp may be placed under it in cold weather. This will give the chickens warm water all winter.



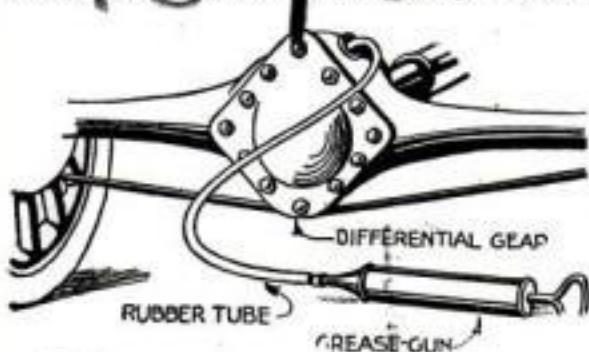
How a large square oilcan may be transformed into an automatic fountain for chickens

THE HOME WORKSHOP

Try a Rubber Hose on the Grease-Gun

IT'S a messy and tiresome job at best to keep the differentials and transmission filled to the proper level with grease, and the job is often neglected for this reason.

If a piece of rubber tubing is attached to the grease-gun, it is unnecessary to crawl



Make your grease-gun more effective by adding a rubber tube

under the car to lubricate a transmission.

Procure about 5 ft. of $\frac{1}{4}$ -in. rubber tubing, obtainable at an automobile accessory shop, and wire it to the end of the grease-gun spout.—J. C. OTTOFY.

Transforming a Tea-Kettle into a Glue-Pot

OUT of an old kettle and a tin can, I have made the glue-pot illustrated and it has given satisfactory service.

An old water-kettle that I found in the attic was used for the water container, and an old tomato-can for the glue receptacle.

A ring about $\frac{1}{2}$ in. wide was cut from a piece of galvanized iron, and soldered to the outside of the can to keep it from resting on the bottom of the kettle, and also to keep the kettle steamtight.

CAM
COLLAR
CAM 1" FROM BOTTOM

The water in the kettle prevents the glue from burning

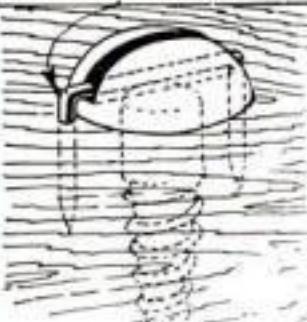
How to Prevent a Wood-Screw from Loosening

WOOD-SCREWS will quite often loosen in any construction where there is continued vibration. These may be effectively locked by the method shown.

The screw is tightened down in the usual way. A straddle tack is placed over the head of the screw and driven down, the middle section of the tack fitting into the slot of the screw.

If the tack is not wide enough to fit over the head of the screw, a small brad may be driven down beside the screwhead and bent over until it fits in the slot. Either way provides a simple method of keeping the screw from turning.—L. R. BUTCHER.

STRADDLE TACK



Slot-head screws may be locked as shown

What a Glad Surprise On Xmas Morn!

A LIONEL TRAIN is a wonderful gift; it so perfectly resembles a real train. You've watched the long, graceful lightning express go speeding by like a rocket—engineer with tense grip on the throttle, eyes steadily ahead! Didn't it make you eager to be master of a genuine railway system? Well, a Lionel Railway will gratify that ambition, because it looks and operates like a real electric railway.



This train is drawn by our famous high-power TWIN-MOTOR locomotive.

Standard of the World for 21 Years

Tell Dad you want a "Lionel" for Xmas. He'll be interested when you tell him it is so sturdily built it will last for years. Be sure it's a LIONEL.

Send for the New Xmas Catalog

—showing the complete Lionel line of Locomotives with single motors or with twin-motors, Coaches, Freight Cars, Stations, Bridges, Semaphores, etc., in full color—over 150 items. Then buy from your dealer or write us. Prices from \$6.25 up.



Electric Warning Signal
Electrical bell rings when train approaches crossing.



New Lionel Type "A"
Multivolt
Toy Transformer

Approved by National Board of Fire Underwriters. Cheapest, and best transformer made. Many improved electrical features.

The Lionel Corporation,
50-B, East 21st St.,
New York City

LIONEL ELECTRIC TOY TRAINS



The Reproducer with the movable coil

The Radio MAGNAVOX

The marvelous wonder instrument that makes the joys of wireless and wireless music easily obtainable to everyone at small cost. Faithfully reproduces all sounds and tones loud and clear in any volume desired. Anyone can operate it. No special knowledge or experience necessary. Our representative sets up outfit and gives you complete service.

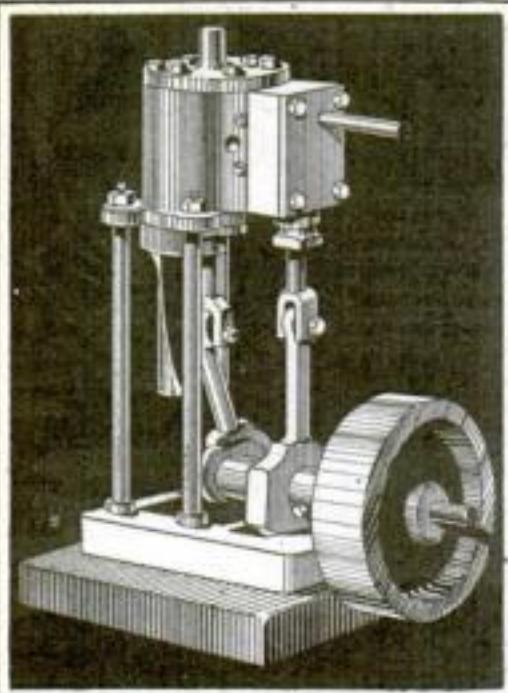


MAGNAVOX COMPANY, OAKLAND, CALIFORNIA
New York Office: 370 Seventh Avenue, Penn. Terminal Bldg.

GENTLEMEN:—
Please send me prices and full particulars concerning the Radio Magnavox and complete outfit for receiving messages and music by wireless.

NAME _____

ADDRESS _____



GET A HOBBY MAKE MODELS

Start a Home Workshop

"Model Making," by R. F. Yates, describes the construction of gas-model engines, steam-engines, locomotives, boats, dynamos, turbines, railroads, guns, etc. Thirty chapters are devoted to models of various nature.

It will help you to become a better mechanic. It will help you to do hard soldering, soft soldering, lathe work, tempering, drilling, pattern-making, etc.

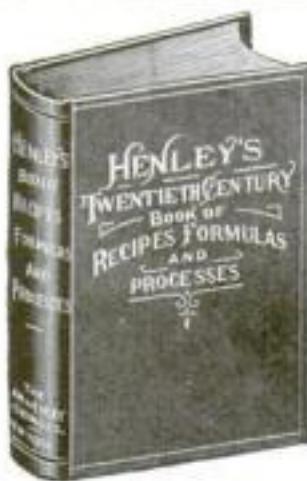
This is a book every amateur or professional mechanic and model maker should have.

"Model Making" describes real engineering models, not toys.

400 Pages, 300 Illustrations. Practical, complete, easily understood. Price, Postpaid, \$3.00.

Popular Science Monthly

225 West 39th Street, New York



TWENTIETH CENTURY Book of Recipes, Formulas and Processes

This book of 800 pages is the most complete Book of Recipes ever published, giving thousands of recipes for the manufacture of valuable articles for every-day use. Hints, Helps, Practical Ideas and Secret Processes covering every branch of the useful arts are given.

10,000 Practical Formulas—The Best Way to Make Everything

A book to which you may turn with confidence that you will find what you are looking for. A mine of information, up-to-date in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work.

Price \$4.00

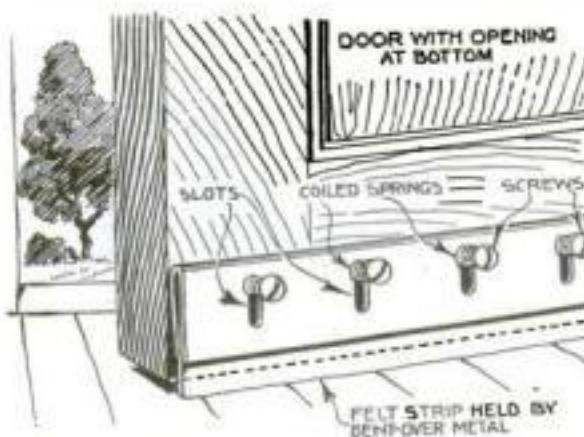
Popular Science Monthly
225 West 39th Street, New York

THE HOME WORKSHOP

This Weather Strip Will Adjust Itself

A WEATHER strip on the bottom of the front door must close the open space entirely to exclude the cold, but when the door is swung inwardly the weather strip will strike the carpet and prevent the opening of the door. The strip shown in this illustration corrects this common defect by having narrow slots instead of screw-holes.

When the strip strikes a high place it slides upward, and when the door is closed again the strip falls by its own weight and



Save coal by providing your outside door with one of these self-adjusting weather strips

makes a perfect closure. Round-headed screws are used and they are turned in just far enough to permit the up-and-down movement of the metal piece. An oxidized strip bent double at the top and with a piece of felt or rubber between the layers at the bottom is used. It makes a very neat and serviceable door-strip and may be used for many years.

In the summer the strip is pushed up to its extreme height and held there by tightening on two of the outside screws. In the cold weather these screws are loosened and the strip again becomes a barrier to wintry blasts.

Indirect Light from an Old Wash-Basin

THE worker who finds need for indirect lighting in his workshop will find this a satisfactory way to secure it. First the ceiling is painted white and the inside of an



Good light is necessary for doing good work and indirect lighting is superior to direct lighting

old metal wash-basin is also painted white. The basin is then suspended from the ceiling in the manner shown. The rays of light are first reflected to the ceiling and then distributed over the room.

Learn Chemistry at HOME

Dr. T. O'Conor Sloane Will Teach You



No profession offers such alluring opportunities. Many industrial firms pay their chemists from \$10,000 to \$15,000 a year. Dr. Sloane will teach you chemistry by a practical, intensely interesting method. Our course is remarkably simple. No special education required—if you can read and write English you can understand every lesson. Dr. Sloane teaches you in your own home by the same successful system by which he has already taught thousands in the class-room.

Pay As You Go Along

The price of our course is very low and the tuition includes everything, even the chemistry outfit—there are no extras to buy with our course. You can pay in small monthly amounts as you go along. Our plan places a chemical education within the reach of everyone.

Big Chemistry Outfit Given FREE to Every Student

We give to every student a valuable chemistry outfit which could not be duplicated for less than \$25.00. This outfit includes everything you need for the entire course and is given absolutely free.

SPECIAL 30 DAY OFFER

In addition we are making a special offer for a short time only. You owe it to yourself to find out about it. Write for free book "Opportunities for Chemists" and full details of our free outfit and special offer. Act today before this offer is withdrawn.

CHEMICAL INSTITUTE OF NEW YORK, Inc.
Home Extension Division
140—S-Liberty Street New York City

WHY BE A WALLFLOWER?

YOU Can Now Learn to Dance at home, quickly, through Arthur Murray's remarkable invention; fascinating new method; surprisingly easy! No music or partner needed; 10,000 have learned dancing by mail! Success positively guaranteed! Proof! One lesson absolutely free to prove you can learn by our amazingly simple method. For mailing, etc., send 10c today! If you can dance, learn to teach. Write for details.

ARTHUR MURRAY, Studio 43, 290 Broadway, N.Y.



2 YEAR GUARANTEED BATTERIES SAVE 50%



ROYAL
Storage Batteries
GUARANTEED
2 YEARS

Specimen Prices
Ford-Dort - - \$18.00
Overland-Buick - 21.85
Maxwell-Dodge 25.00
All Other Cars Supplied
at Equally Low Prices.

Largest Exclusive Mail Order Battery House in America

Semi CORD TIRES 5000 Mile Written Guarantee

Most modern and lasting of reconstructed tires. These semi-cords are heavily reinforced with genuine New Goodyear or Miller "geared to the road" treads and will give wonderful service. Do not confuse them with sewed or half soled tires. A remarkable low factory purchase enables us to offer these guaranteed tires at smashed prices.

Standard Make	TUBE FREE	Fresh Stock
28 x 3	\$6.90	32 x 4½ \$12.90
30 x 3	7.15	33 x 4½ 12.90
30 x 3½	8.35	34 x 4½ 13.40
32 x 3½	9.10	35 x 4½ 13.90
31 x 4	10.20	36 x 4½ 14.40
32 x 4	10.70	33 x 5 15.10
33 x 4	10.95	35 x 5 15.10
34 x 4	11.70	37 x 5 15.60

SEND NO MONEY
Pay only after examination
at express office. Unwrapped
section for inspection. If cash
with order, deduct 5 per cent.
Cost you nothing to send for tire.
Write today. Return if not like new.

HUDSON TIRE CORP.
391-A Harrison and Peoria Sts., CHICAGO, ILL.

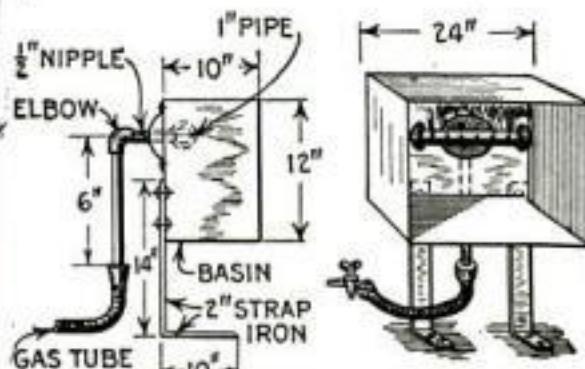
Copyrighted material

THE HOME WORKSHOP

Old Sink Forms Foundation for Gas-Stove

FROM an old drain-basin with a 10-in. piece of 1-in. pipe, a $\frac{1}{2}$ -in. nipple of $\frac{1}{2}$ -in. pipe, $\frac{1}{2}$ -in. elbow, 6 in. of $\frac{1}{2}$ -in. pipe, and 2 plugs, I made a very serviceable stove. The legs were made of two pieces of old strap iron 2 in. wide and 24 in. long, bolted with two $\frac{1}{4}$ -in. stove-bolts to the back of the basin. They were bent in an L-shape, one leg 10 in., and the other 14 in. long. In each leg two $\frac{1}{4}$ -in. holes were drilled.

The bottom of the basin had a 5-in. hole in it. This was covered with another piece of tin, an old pot-cover hammered into a



This simple type of gas-stove may be made from an old drain-basin

cup shape, in which a $\frac{1}{2}$ -in. hole was drilled for the $\frac{1}{2}$ -in. nipple that was connected with the 1-in. pipe. This 1-in. pipe was tapped in the center for the $\frac{1}{2}$ -in. nipple. The ends were capped. On the opposite side from the $\frac{1}{2}$ -in. tapped hole 1/32-in. holes were drilled $\frac{1}{2}$ in. apart; these were the burner holes. To assemble: the caps were screwed on to the 1-in. pipe, then the nipple was tightened into the 1-in. pipe; this was put inside of the basin. The nipple was just long enough to reach through the cup shape of tin.

When the elbow was tightened it held the burner in place. The 6-in. pipe connected the stove by a tube with the gas-plug. I used this stove all winter with success.—L. K. LANIER.

Homemade Cook-Book Holder for the Housewife

HERE is a convenience for the kitchen that is easily made. It can be made any size desired.

A piece of tin is bent at one edge over a small piece of wood, just wide enough to



Your wife will appreciate this device for holding the cook-book

support the edge of the cook-book at the bottom. Two nails driven through the tin at opposite ends hold it securely. A wire bent as shown and secured in the ends of the wood will hold the book open at any page desired.—K. H. HUNTING.



FRANK D. HENNESSY
Pres. and Gen'l Mgr.

Found Guilty!

A GREAT mechanical training institution has been found guilty on two indictments: first of giving *too much individual instruction and personal consideration*; second, convicted by its own graduates of giving two much for the money.

The President of this institution has been sentenced for life at hard labor, holding down his present job as head of this wonderful school because of his proved ability to help men help themselves in these times when so many need help. He knows that there is no reason for any man with a real back-bone being out of a job. These are days of the trained man. The man who is properly trained should never be out of work.

Here is *Your Opportunity*

—To be a *Trained Man*. Learn Motor Mechanics—Let "The Quality School" prepare you for jobs paying \$200-\$400 a month.

Plan at once to start the new year right—in a permanent business with big, wide-open opportunities. Thousands of skilled motor mechanics are constantly needed in the cities, on the farms and in the aviation fields.

Here you learn by doing everything about the care, repair and operation of auto trucks, tractors, stationary gas engines and airplane mechanics. You work with the most modern equipment and motors, including the Liberty Motor.

Learn by Big Shop Standards—Thoroughly—in 7 Weeks

We teach you the practical big shop methods. *Our test and trouble work alone is worth the price of the entire course.* No education or experience required. You work with tools—not books. Our graduates are recognized everywhere as exceptionally competent workmen. Thousands are holding good steady jobs or are

making big money in their own shops. Like scholarship privileges.

Special Business Course—Your choice of a thorough business training or complete instruction in Bookkeeping and Modern Shop Records and Management as part of regular course.

Y.M.C.A. MEMBERSHIP. Swimming Pool, Boxing, Wrestling, Library, etc. No extra charge.

BIG FREE Book

tells all about the opportunities in Motor Mechanics and our big shop standards of instruction. Write today.

"The Quality School"

Pronounced by official inspectors,
"one of the best in the country."



F. D. Hennessy, President and Manager,
IOWA STATE AUTO & TRACTOR SCHOOL,
769 Nebraska St., Sioux City, Iowa.
Please send FREE Book.

Name _____
Address _____
Town _____
State _____

Handicraft for Handy Girls

With suggestions for the girl who likes to make things. Also for the camp fire girl and the one who likes to play and work out of doors. Price, postpaid, \$2.15.

Popular Science Monthly, 225 West 39th Street, New York City

THE NEW METAL WORKER PATTERN BOOK. By G. W. KITTRIDGE AND ASSOCIATES. The most complete book on metal pattern work published. It contains 259 problems, including 65 on triangulation. 544 pp., 900 figs. Price \$7.50 Pop Sci Monthly, 225 W. 39th St., New York

Don't Wear a Truss

Brooks' Appliance, the modern scientific invention, the wonderful new discovery that relieves rupture, will be sent on trial. No obnoxious springs or pads.



MR. C. E. BROOKS

Brooks' Rupture Appliance

Has automatic Air Cushions. Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. Sent on trial to prove it. Protected by U. S. patents. Catalog and measure blanks mailed free. Send name and address today. Brooks Appliance Co., 255D State St., Marshall, Mich.

POOL AND BILLIARDS

Learn to become an expert player through scientific methods used by champions and ex-champions. Thorough course to study at home. Write for information.

PROGRESSIVE EXTENSION INSTITUTE
1174 Phelan Bldg., San Francisco, Calif.

You Can Save \$50.00

By recovering your old auto top frame yourself. We make these recoveries to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, webs and tacks. All complete. Give us the name, rear and model number of your car and we will send you our catalogue with samples and quote your exact price.

LIBERTY TOP & TIRE CO. Dept. E8, Cincinnati, O.



LEARN MUSIC AT HOME!

Play by Note
Piano, Organ,
Violin, Cello,
Guitar, Banjo,
Mandolin, Harp,
Cello, Trombones,
Flute, Clarinet,
Piccolo, Saxophone,
Ukulele, Sightsinging,
Hawaiian Steel
Guitar, Harmony
and Composition,
Tenor Banjo,
Drum & Traps,
etc.

Music no longer difficult! New plan makes it easy to learn by home study. Positively easier than with private teacher. Faster progress. You will be able to play your favorite instrument in a few short months! More than 250,000 men, women and children have learned by our method. You, too, can learn in your spare time.

Amazing Offer

We want to have one pupil in each locality at once to help advertise our home study method. For a short time, therefore, we offer our marvelous lessons at practically no cost, charging a sum amounting merely to about the cost of sheet music. Beginners or advanced pupils. Write for amazing free book giving all the facts and particulars. Send a postal today!

Instruments supplied when needed, cash or credit.

U. S. School of Music
812 Brunswick Bldg., New York City



H. S. Whiteman, New York, writes: "You are on your wonderful system. Did not know one note from another, but in a short time have mastered the piano and am now composing music."



C. N. Pitts, Ga., writes: "Have completed your course on violin. Now have 15 students."



Louise Bowles, Vicksburg, Va., writes: "Received my teacher's certificate. Highly recommend your school and wouldn't take anything for the help it has given me."

TREAT YOURSELF

RenuLife VIOLET RAY



Learn how Violet Ray treatment enriches impoverished blood, relieves nervousness and builds vital strength. Drives out aches and pains and removes the cause. Speeds up digestive process, promotes assimilation of food and elimination of waste products.

Absolutely shockless and safe. You spray thousands of volts of high frequency electricity into any weak, inactive organ or tissue. Satinates entire body, relieving congestion and flooding it with rich, fresh, strength-building blood. Endorsed by physicians—25,000 in use.

Get "HEALTH" Book Sent for the asking. Tells you the whole story of the Violet Ray, its successes, many uses, etc., how simply and effectively you may employ these wonderful, corrective forces of nature. Write at once.

RENULIFE ELECTRIC COMPANY
1812 Marquette Bldg., Detroit, Mich.
Canada, Netting Bldg., Windsor, Ontario
Sales agents write for attractive picnics



Only \$45.00 For This Job Complete

Saves exorbitant freight rates and one-half original cost by buying Ford Speedster Bedside knock-down. Simple, complete instructions furnished, all parts cut to exact fit. Any one can assemble this job. Complete with hood, radiator shell, instrument board, upholstering, metal parts, wood parts, bolt screws, etc. Flat radiator shell furnished made up. Designed low with lack of wind resistance. Price set up \$80, further particulars on request. The Central Auto Supply Co. Eng. Dept. 122 Louisville, Ky.

Net Paper Patterns
All Parts Complete

Complete with hood, radiator shell, instrument board, upholstering, metal parts, wood parts, bolt screws, etc. Flat radiator shell furnished made up. Designed low with lack of wind resistance. Price set up \$80, further particulars on request. The Central Auto Supply Co. Eng. Dept. 122 Louisville, Ky.

Play the Hawaiian Guitar Just Like the Hawaiians!

Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it! We have reduced the necessary motions you learn to only four—and you acquire these in a few minutes. Then it is only a matter of practice to acquire the weird, fascinating tremolos, staccatos, slurs and other effects that make this instrument so delightful. The Hawaiian Guitar plays any kind of music, both the melody and the accompaniment. Our complete course of 52 lessons includes FREE a beautiful Hawaiian Guitar, all the necessary picks and steel bar and 52 pieces of music. Special arrangement for lessons if you have your own guitar.

"This Makes a Splendid Christmas Gift"

Send Coupon NOW

Get Full Particulars FREE

First Hawaiian Conservatory of Music, Inc.

233 Broadway (Woolworth Bldg.), New York City

I am interested in the HAWAIIAN GUITAR. Please send complete information, special price offer, etc. etc.

NAME.....

ADDRESS.....

TOWN..... COUNTY..... STATE.....
Print name and address clearly. 12 P.S.M.



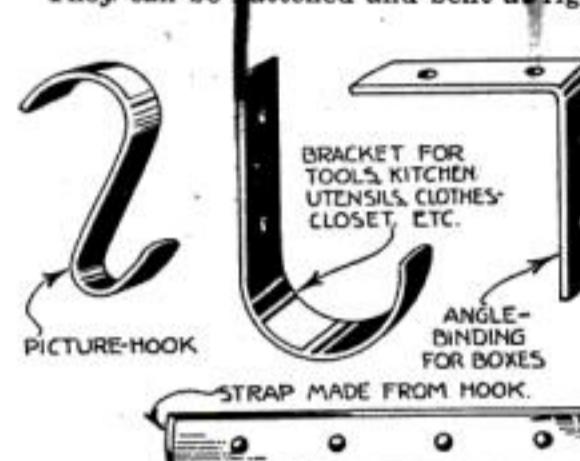
THE HOME WORKSHOP

Some Uses for Picture-Hooks for Hanging Pictures

COMMON brass picture-hooks can be put to a variety of uses for which, ordinarily, special strips must be cut.

If they are hammered out flat and then punched for round-headed screws, they make fine ornamental strips for putting on homemade furniture.

They can be flattened and bent at right



Picture hooks may be bent in various ways to adapt them to other uses

angles and used as angle bindings for boxes or cabinets.

They may also be partially straightened out and used as brackets for supporting such tools as braces, hand drills, drawing-knives, etc.

In the kitchen, when screwed to the wall, they make excellent supports on which to hang kettles, dishpans, or other utensils.

If tacked around the walls of closets, articles of clothing may be hung upon them. Other uses will naturally suggest themselves.—L. H. KIRBY.

Shutter-Frames Can Be Used for Window-Screens

NEEDING some screens for the windows I brought from the cellar some old shutters.

Selecting those that fitted the windows I wished to screen, I removed the slats by sawing them on one end. They then



Practical window-screens may be made from old shutter-frames

dropped out, leaving a good strong frame.

Over these frames I tacked screen wire. After painting them, I put them on the windows. The hinges and catches were still in place. The screens were very satisfactory, as they could be thrown open, allowing one to shake dusters, etc.—Mrs. H. E. HOLD.



Reduced Prices

and THREE YEARS TO PAY for this beautiful

MEISTER PIANO

Eight exquisite styles to choose from and the one you select will be sent you on

30 DAYS FREE TRIAL—ALL FREIGHT PREPAID

A guaranteed saving of \$100 to \$150.

If you like the piano we will sell it to you on small monthly payments to suit your convenience as low as \$8.00 per month. No cash deposit asked. No interest on payments. No extras of any kind. Stool free with piano. Write today for our catalog, illustrated in the natural colors of the wood. It's free. If you are interested in player-pianos send for free catalog. We have a fine selection. Rothschild & Co., Dept. 11 Chicago

High Frequency Apparatus

By T. S. CURTIS

This book covers the design, constructions and practical application of all kinds of high frequency apparatus for use in experimental, medical and plant cultivation work, and also includes directions for the construction of a complete stage outfit for both low and high potential work.

266 pp., illus. Price, \$3.00

POPULAR SCIENCE MONTHLY

235 West 39th Street,

New York City

Be an Artist

COMICS,
CARTOONS,
COMMERCIAL,
NEWSPAPER AND
MAGAZINE
ILLUSTRATING,
FASHION PASTEL

AND CRAYON PORTRAITS. Earn \$50 to \$200 a week. By our simple method your talent is quickly developed without interfering with present work. BY MAIL OR LOCAL CLASSES. Write for full particulars. List of successful pupils, illustrated prospectus.

Associated Art Studios, 23d St. and Broadway
A27 Flatiron Building, New York, N. Y.

DIAMONDS WATCHES ON CREDIT

Send for Catalog

GENUINE DIAMONDS
GUARANTEED

For Christmas Gifts

Prices Cut 33 1/3%

CASH OR CREDIT

Write for Free Wonderful Bargain Catalog today. Credit terms fully explained.

Amazing money-saving prices on Diamonds, Watches and Jewelry.

DIAMOND RINGS, \$25 up.

Signet Rings, \$8 up.

Birthstone Rings, \$12 up.

OPEN A CHARGE ACCOUNT

Wrist Watch Solid 18-K White Gold, looks like platinum.

Fine Jeweled Imported movement. Guaranteed. Silk Ribbon Bracelet, Special at \$25. Other

Solid Gold Wrist Watches, \$26 up.

Gold filled, \$15 up. Men's

Watches, Gourmet, \$17.50 up.

SEND FOR CATALOG. Liberty Bonds Accepted

LADY LOUISE DIAMOND RING

Solid 14-K Green Gold; Diamond set in Solid White Gold. \$125 Values, now.

\$83.33 CASH OR CREDIT

USE YOUR CREDIT

LADY LOUISE DIAMOND RING

Solid 14-K Green Gold; Diamond set in Solid White Gold. \$125 Values, now.

\$83.33 CASH OR CREDIT

SEND FOR CATALOG. Liberty Bonds Accepted

The OLD RELIABLE CREDIT JEWELERS

Dept. G-871

LOFTIS BROS & CO. LTD.

108 N. State St., Chicago, Ill.

Stores in Leading Cities

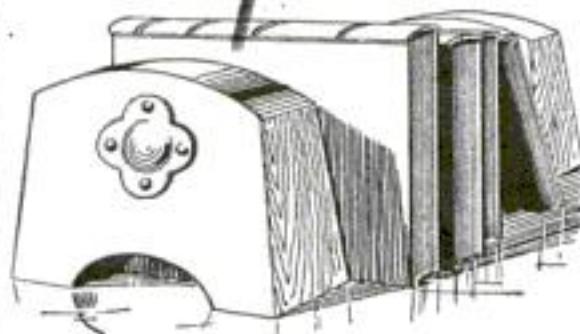
Copyright material

THE HOME WORKSHOP

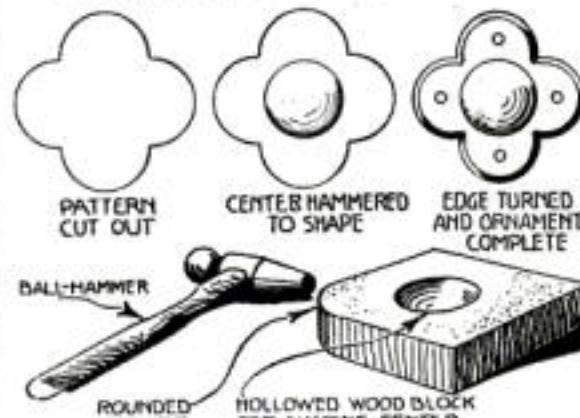
Ornaments of Hammered Brass Are Welcome Gifts

ORNAMENTS of hammered brass are very effective for decorating bookends, desk sets, pipe-racks, etc., and the only tools required for making them are an old pair of scissors, a round-headed hammer, a gouge and some blocks of hard wood.

Draw some circles and ovals on the end grain of the wooden blocks and with the gouge work them out into smooth depressions of any desired depth. Make a



ORNAMENT USED ON BOOK-ENDS



Handsome ornaments of hammered brass may be made with simple tools

pattern of the proposed ornament on paper, cut this out, lay it flat on some sheet brass $1/32$ in. thick, and mark around it with a lead-pencil. The brass is then cut out with the scissors.

Suppose you use the quatrefoil design illustrated. First place it carefully centered over a circular depression in the block and beat it gently with the head of the hammer until the brass bulges and fits the hollow. Next hold the brass with the bulge upward so that the edge projects over a rounded corner of the wood and tap it so as to bend the rim. Keep turning until the entire edge is rounded over. Then punch the brad- or screw-holes and the ornament is complete. Polish with fine sandpaper or emery.—L. H. KIRBY.

How to Improvise a Slide-Easy Collar

UNWIELDY starched collars are quickly converted into slide-easy collars by putting a pipe-cleaner well up into the crotch of them, as shown in the illustration. The tiny bristles prevent the cleaner from working down while the collar is worn, and the tie will slide through it easily, without requiring any effort.—A. SCHAALE.



A hint for those who wear turn-down collars

**New Easy Way to Become An Artist**

THIS wonderful new method makes it possible for anyone to learn Illustrating, Cartooning, or Commercial Art. Hundreds of our students are now making splendid incomes. And most of them never touched a drawing pencil before they studied with us.

The simplicity of this method will astound you. You will be amazed at your own rapid progress. You learn by mail—yet you receive personal instruction from one of America's foremost Commercial Artists—Will H. Chandlee. Get into this fascinating game NOW. You can easily qualify. A few minutes' study each day is all that is needed.

learn how to put them together. Now you begin making pictures. Shading, action, perspective, and all the rest follow in their right order, until you are making pictures that bring you from \$50 to \$500 or more! Many artists get as high as \$1,000 for a single drawing!

Write for Interesting Free Book

Mail coupon now for this interesting free book "How to Become an Artist." Explains about this amazing method in detail. Tells of our students—and their wonderful progress—and how we can qualify you for a high-salaried artist's position. Also tells of our free artist's outfit and special low offer to a limited number of new students.

MAIL COUPON NOW!**Washington School of Art**

Room 1708, Marden Building, Washington, D. C.

----FREE COUPON----

WASHINGTON SCHOOL OF ART
Room 1708, Marden Bldg., Washington, D.C.

Please send me, without cost or obligation on my part, your free book, "How to Become an Artist."

Name... Please state whether Mr., Mrs. or Miss.

Address...

Modern American Telephony in All Its Branches

By A. B. SMITH

A thoroughly practical, comprehensive treatise, including descriptions of apparatus, line construction, exchange operation, construction of underground conduits, cables, aerial lines, sub-stations, switch-boards and the central office.
800 pp., 600 illustrations. Price, \$2.00

Popular Science Monthly, 225 W. 39th St., New York



SMITH TYPEWRITER SALES CO.
(Harry A. Smith) 306-218 No. Wells St., Chicago, Ill.

**Be a Lawyer**

Law trained men earn big money and occupy top positions in social, business and public life. \$5,000 to \$10,000 a year is what you can earn. Our improved system guides you step by step until you have passed the bar examination in less than a cent. Our money refund guarantee protects you. Low cost, easiest terms. We furnish everything including complete Law Library. Send for free catalog.

American School, Dept. L-975, Broad & 58th, Chicago



For your home or business; for washing and ironing machines, garage or machine shops, house pumps, printing machinery, etc. A general utility motor for many purposes. Thoroughly tested, high quality, moderate price.

Quality Motor Bargain

Columbia Motor—for A. C., $\frac{1}{4}$ h. p., 1p., 25, 40, 50 or 60 c., 110 v., 1750 R. P. M., with 10 ft. cord and plug, also 2 in. grooved pulley. Also furnished for D. C., 32 v., 110 v. or 220 v.

10 day money back guarantee. Sent prepaid on receipt of your order with money.

Inquiries solicited on all types and sizes of motors.

Interesting proposition to agents.

(Tear off coupon and mail today)

Check motor desired Address Department No. D

A. C. 110 v.; 25 c.... 40 c.... 50 c.... 60 c....

D. C. ; 32 v.... 101 v.... 220 v....

Name.....

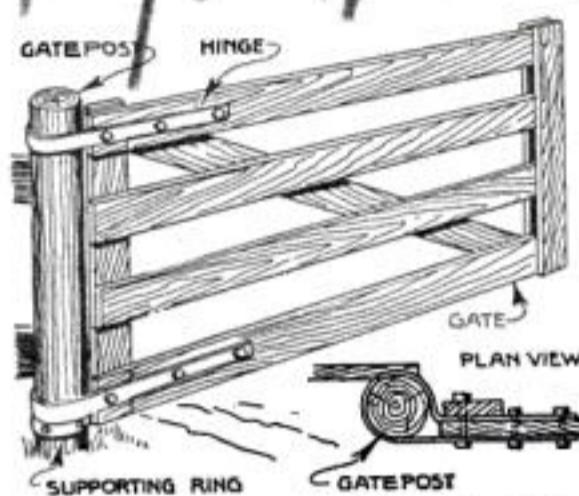
Address.....

The Columbia Electric Mfg. Co., CLEVELAND, OHIO

THE HOME WORKSHOP

Wide-Swinging Gate for the Farmyard

A GATE that may be swung through nearly 360 degrees may be made by using an offset ring-hinge such as is shown in the illustration. The line of the gate is on the opposite side of the post from the line of the fence, and this construction allows of swinging the gate back against the fence on either side, which is often very

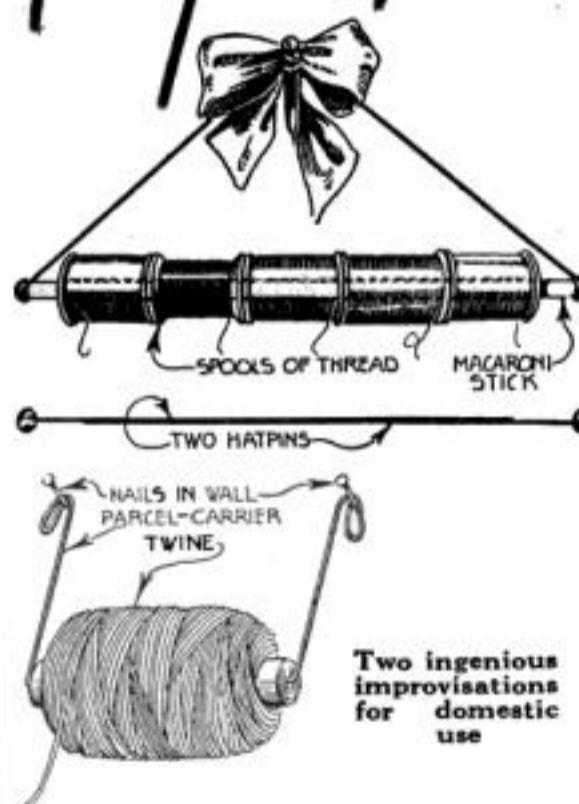


When swung open as far as it will go, this gate will be flat against the fence.

desirable. The mounting below the lower hinge should be a solid ring, to allow of free rotation of the hinge upon it. The post used for a hinge-post should, of course, be round. The post on the other side of the gate should be so placed as to allow the gate to pass it if the maximum swing of the gate is desired.—LOUIS SCHNEIDER.

Novel Spool- and Twine-Holders and How to Make Them

THE spool-rack in the picture is made from a straight stick of macaroni and a pair of long hatpins. When necessary to put on a new spool, simply pull out one of



Two ingenious improvisations for domestic use

the pins. It's so convenient to have all of your spools right at hand when sewing.

The other picture shows a single-spool holder made from one of the handles the grocer gives away for carrying parcels home. Keep some of them, for they make the handiest twine-holders. Always have one in a convenient place in the kitchen and laundry.—JENNIE E. MCCOY.

How the Man in Maine Buys Oregon Apples

COMMERCE lives through the interchange of products. California fruits are sold in Maine. Shoes made in New England are worn on the Pacific slope. Automobiles from Detroit traverse the Florida sands; the North Smokes Southern tobacco. And so it goes.

Advertising has played an all important part in fostering business growth. Without it we would retrograde half a century, or more. Business would stagnate; large institutions which build cheaply by large production would fade into oblivion; we would live in total ignorance of many things which might add to our wealth, health and happiness.

The bread and butter of business depend on advertising, and your interest in it.

Read the advertisements. They will be as productive of results to you as to the companies that pay for them. In half an hour, or less, you can learn much of many things that go to make life what it is.

Read the advertising. It enables you to get more for your money by telling you what to buy. It is your guide to what's good to get.

Read it—reflect on it—it pays

DIAMONDS and other Jewelry ON CREDIT



BUY TODAY **10 MONTHS TO PAY**



Beautiful Xmas Gifts On Credit—at Cash Prices

Blue white, perfectly cut diamonds, handsome watches, dainty toilet articles. Your choice ON APPROVAL. If satisfied after examination, pay only 1-5 the price—balance in ten monthly payments. ABSOLUTELY NO RISK.

Send for FREE
De Luxe Christmas Catalog

Thousands of exquisite designs to choose from—
every article a Rare Bargain. "Satisfaction guaranteed or your money back." Ten Months to pay on everything. Write today. Address Dept. 471-T

Capital \$1,000,000

"THE HOUSE OF QUALITY"
L-W-SWEET INC.
1650-1660 BROADWAY, NEW YORK

Books for Mechanics

Sheet Metal Work—A manual of practical self-instruction in the art of pattern drafting and construction work in light and heavy-gauge metal, including skylights and roofing, cornice work, etc. Cloth, 288 pages, 370 illustrations. Price, \$2.60, Postpaid.

Machine Shop Work—A comprehensive guide to the most approved methods in modern shop practice, the construction and use of improved tools and machines, hand tools, the lathe and lathe tools, the methods of screw cutting, taper and eccentric turning, etc. Leather, 360 pages, 401 illustrations. Price, \$2.60, Postpaid.

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York

THE HOME WORKSHOP

Spinet is Transformed into Bookcase and Desk

ONE day, while rummaging in the attic, I conceived the idea of transforming an old spinet stored there into a useful piece of combination furniture.

The spinet was of mahogany, standing 40 in. high. It was 4 ft. in length and 3 ft. 9 in. at its widest point. The first thing I did was to remove the keyboard and the mechanism in the interior of the instru-



What was done with an old spinet may suggest similar transformation of other old furniture

ment. Next I built into the fore part of the old spinet two sets of small drawers on each side and partitioned off a number of pigeon-holes of various sizes. Then the affixing of a hinged writing surface supported by two metal quadrants gave to the front of the former instrument the ordinary appearance of a comfortable writing-desk. Furthermore, by means of a pair of movable supports, I made the music-stand adjustable so that it could be lowered to serve as a convenient bookrest or raised to act as a lid for the desk by folding over flush with the top. The music-stand and writing surface met at right angles when closed, forming a firm protective covering and changing the article into a quaint library table.

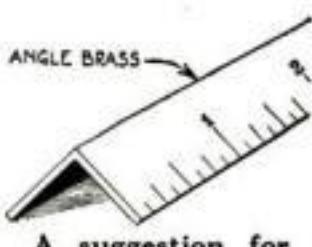
I divided the rear portion of the body of the former spinet into three parts for the storing of books. The volumes were put in with titles uppermost.

In addition, I fashioned a large drawer to be used for keeping papers, booklets, and the like in each side of the desk in such a way that they were wholly unseen. These drawers were opened by clutching them with the hand on the under side.

To open the combination bookcase, library table, bookrest, and desk, finally, one had but to touch a pedal of the former spinet, which released the catches holding the music-stand and writing surface in position.—L. C. GOBETZ.

A Convenient Ruler that Does Not Slip

THIS ruler consists merely of a length of angle-brass with $\frac{1}{2}$ -in. flanges. Select a smooth piece and finish the ends neatly and the job is done. If you wish, you may mark an inch-scale on it. Use the ruler with the corner up. It gives a hold for the hand better than any except the triangular ruler, and it has the advantage because it will not slip. For this last reason it is very useful for cutting where considerable pressure must be used. — HOWARD GREENE.



A suggestion for the drafting-room

Here's a Book You Ought to Have ELECTRICITY



45 Illustrations
414 Pages
\$1

HERE'S just the book on Electricity that you need to answer your many questions—to solve your knotty problems, to teach you new kinks, to be your memory for tables, rules, formulae, and other Electrical and Mechanical facts. With this "Little Giant" I. C. S. Electrical Engineer's Handbook within easy reach, an hour or a day need not be lost "digging up" some unfamiliar fact; you'll just turn to the index and get it "in a jiffy." A few of the subjects treated are:

Electricity and Magnetism; Batteries; Circuits; Magnets; Direct and Alternating Currents; Dynamos and Motors; Belts; Shafting; Electroplating; Electrical Measurements; Meters; Arc and Incandescent Lamps; Mercury-Arc Rectifiers; Transformers; Insulation; Electric Cars; Single and Multiple Unit Control; Transmission; Rail Welding; Tables of Wires—Sizes, Capacities, etc.; Mathematical Rules, Formulas, Symbols; Tables of Constants, Equivalents, Roots, Powers, Reciprocals, Areas, Weights and Measures; Chemistry; Properties of Metals; Principles of Mechanics.

This Electrical Engineer's Handbook is just one of 22 I. C. S. Handbooks covering 22 Technical, Scientific and Commercial subjects, all equally crowded with value. They have the contents of full-size books condensed into pocket size, ready to go with you anywhere and be at your instant command.

You run no risk! Money back if desired!

— TEAR OUT HERE —
INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7650-B, Scranton, Penna.

I enclose \$ _____ for which send me, postpaid, the Handbooks marked X, at \$1.00 each. It is understood that if I am not entirely satisfied I may return any or all of them within five days and get my money back.

- | | |
|--|---|
| <input type="checkbox"/> ELECTRICITY | <input type="checkbox"/> Bookkeeper's |
| <input type="checkbox"/> Westinghouse Air-Brake | <input type="checkbox"/> Steno.'s and Correspondent's |
| <input type="checkbox"/> Civil Engineer's | <input type="checkbox"/> Business Man's |
| <input type="checkbox"/> Mechanic's | <input type="checkbox"/> Advertiser's |
| <input type="checkbox"/> Steam Engineer's | <input type="checkbox"/> Salesman's |
| <input type="checkbox"/> Concrete Engineer's | <input type="checkbox"/> Window Trimmer's |
| <input type="checkbox"/> Teleph. and Telog. Engineer's | <input type="checkbox"/> Cotton Textile Worker's |
| <input type="checkbox"/> Building Trades | <input type="checkbox"/> Mariner's |
| <input type="checkbox"/> Plumber's and Fitter's | <input type="checkbox"/> Farmer's |
| <input type="checkbox"/> Coal Miner's | <input type="checkbox"/> Poultryman's |
| <input type="checkbox"/> Chemist's | <input type="checkbox"/> Automobiles |

Name _____
Street _____
Address _____

City _____ State _____



"Reo" Cluster Metal Shingles, V-Crimp, Corrugated, Standing Seam, Painted or Galvanized Roofings, Siding, Wallboard, Paints, etc., direct to you at Rock-Bottom Factory Prices. Positively greatest offer ever made.

Edwards "Reo" Metal Shingles

cost less; outlast three ordinary roofs. No painting or repairs. Guaranteed rot, fire, rust, lightning proof.

Free Roofing Book

Get our wonderfully low prices and free samples. We sell direct to you and save you all in-between dealer's profits. Ask for Book No. 198.



Lowest prices on Ready-Made Fire-Proof Steel Garages. Set up any place. Send postal for Garage Book, showing styles, THE EDWARDS MFG. CO., 1248-1258 File St., Cincinnati, O.

FREE
Samples &
Roofing Book

PROTECT YOUR HOME and Earnings



With this 25 Cal. regulation blue steel **AUTOMATIC REVOLVER** \$9.75
Regular Price \$22.50
OUR PRICE
While they last

Keep one of these safety revolvers in your home and be fully protected against burglars, thieves and hold-up men. It's a terrible fright to wake up in the night—hear noises down stairs or in the next room—and realize your neglect has left you wholly UNPROTECTED.

Buy one of these revolvers and be always **fully protected**. Handsome blue steel, gunmetal finish. **HAS DOUBLE SAFETY** and is practically "fool-proof" against accidents. Perfect grip, accurate aim. Rifled barrel, checkered grips, safety lever. Holds 7 cartridges. Small, compact, lies flat and will not bulge out pocket. Shoots the famous Colt Auto Cartridges.

SEND NO MONEY

Order to-day. Just send your name and address and say which revolver you want.
No. 345 is 25 calibre, 7 shot. Reg. \$9.75
Regular price \$22.50. Our price.....
No. 745 is larger size, 32 calibre, military model, 10 shot, extra magazine (worth \$1.50) FREE. Regular price \$25.00. Our special price, only.....

Don't wait. Order this bargain today. Write clearly your name, address and the Number of the Revolver you want to order. Send no cash. We ship by return mail. Pay Postman on arrival, our price, plus postage. Send for free catalogue.

Paramount Trading Co.
34 West 28th St., New York City



Learn in Spare Time to be a CIVIL ENGINEER

Earn \$1500 to \$5000 Yearly

Here's your big chance to become a full-fledged Civil Engineer! With this set of books you can fit yourself to make big money, in the greatest outdoor profession on earth! Offer fully explained in coupon. Good only within boundaries of the U. S. and Canada.

Great Books Shipped FREE

Send No Money if you keep them after 7 days' FREE TRIAL.

Nine big flexibly-bound volumes; 3900 pages, 5½ x 8 inches; 3000 plates, maps, diagrams, etc. Written by world's greatest civil engineers. Books tell you ALL ABOUT surveying; highway construction; railway engineering; earth work; specifications; estimating contracts; bridge engineering; masonry; reinforced concrete; water supply; sewers and drains; water power equipment; irrigation engineering—etc., etc. Written in simple language—every point made plain.

Consulting Service Free

A \$12 Consulting Membership solves your difficult problems for a whole year. FREE with the set of books. **SEND NO MONEY—JUST THE COUPON!**



American Technical Society

Dept. C-209, Chicago, U.S.A.

Please send Library of Civil Engineering for seven days' examination, express collect. I will send \$2.50 within seven days and \$3.00 a month until I have paid \$20.00 or return books at your expense.

Name.....

Address.....

Reference.....

THE HOME WORKSHOP

Receiving Rain Warning by Telephone

SOMETIMES it is important to know when rain begins to fall in the night.

One method of obtaining this information is to use a discarded telephone transmitter. Fasten the mouth-piece, mouth up to the roof or any convenient place open to the sky, and over it fix by the corners a sheet of tinned iron in contact with it. Then lead the wires to your bedside, where you will have the dry cells and the receiver part. The rain striking the tin will make a lot of noise which you will hear in bed.—E. A. McCANN.

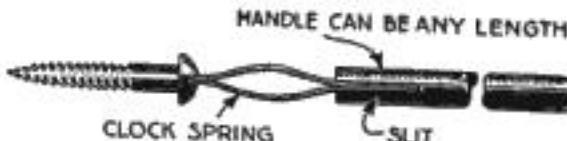


The telephone will enable you to hear the rain falling

Here's an Ingenious Screw-Holder for Starting Screws

IT is sometimes necessary to start screws in a place that cannot be reached with the fingers. When such a condition is met with, the tool shown in the illustration will prove very handy.

A piece of ¼-in. rod is used for the handle and slotted for a distance of about 1 in. at one end by sawing. An old alarm-clock



How to start screws in otherwise inaccessible places

spring furnishes the material for the fingers of the holder. A piece of this is doubled in the middle and forced into the slot in the handle. The fingers are shaped as shown and the ends squared by filing.

To use the holder the fingers are pressed together and slipped into the slot in the screw. After the screw is started, the holder is pulled away from the screw.

One Method of Removing an Obstinate Staple

LARGE staples that are driven in deep or rusted in place are often hard to extract. This can be done easily, however, with the aid of a claw hammer.

Run a big nail through the staple and hook the claws of the hammer under the nail, the claws straddling the staple. Put a piece of wood under the hammer so that the surface will not be damaged, and then pull in the usual way. A very small staple, or double-pointed tack, can be pulled in the same way with the claw end of a hammer.

This kink is well worth remembering

Why delay the purchase of that Tyco Fever Thermometer?

Don't guess about so vital a matter as your health. Keep a Tyco Fever Thermometer in the home.

One of many Thermometers—bath, candy, wall, oven, etc.—made for home use by world's largest makers of temperature instruments. At representative dealers. *Health Booklet Free*

Taylor Instrument Companies
ROCHESTER, N.Y.

There's a Tyco or Tyco Temperature Instrument for Every Purpose

A-119

"BOWLEGS and KNOCK-KNEES" UNSIGHTLY

SEND FOR BOOKLET SHOWING PHOTOS OF MEN WITH AND WITHOUT

The Perfect Leg Forms

PERFECT SALES CO., 140 N. Mayfield Ave., Dept. 45, Chicago, Ill.

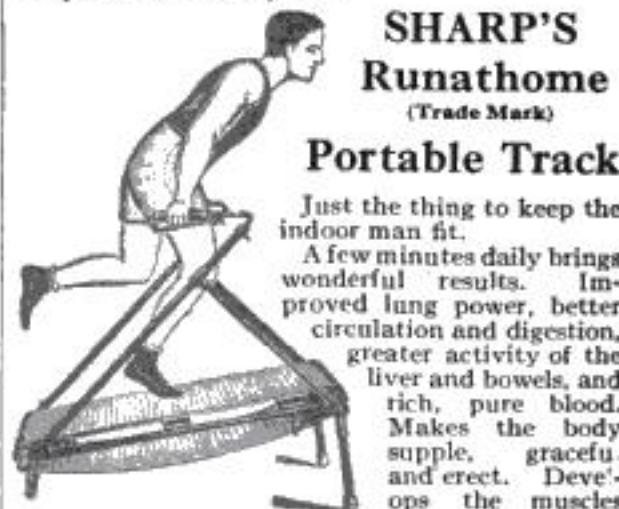
FREE TRIAL

Cut out this ad and Mail it to us, with your name and address (no money); and we will send you our FAMOUS KARNAK RAZOR by return mail, postpaid. You may use the razor for 30 days FREE; then, if you like it, pay us \$1.85. If you don't like it return it. **SEND NO MONEY.** MORE COMPANY Dept. 397 St. Louis, Mo.

RUNNING

the most beneficial exercise

Get all the benefits of a cross country run in your own home, with



SHARP'S Runathome (Trade Mark)

Portable Track

Just the thing to keep the indoor man fit.

A few minutes daily brings wonderful results. Improved lung power, better circulation and digestion, greater activity of the liver and bowels, and rich, pure blood. Makes the body supple, graceful and erect. Develops the muscles most important to health—those in the abdominal tract, supporting the vital organs. The ideal treatment for obesity. Avoid the stoop and lagging step of age. Keep well and strong with the Runathome.

Simply made, nothing to get out of order. Handles adjustable to any size. Folds up compactly. Size when folded 36 x 20 x 7. Weight, 60 lbs.

Sent anywhere prepaid for \$35.

W. N. SHARP

65 E. Lake Street

Chicago, Illinois

The Last Discoverers

(Continued from page 25)

plorer. The man who travels to the ends of the earth to-day is led by the hope of a discovery that will prove of lasting value to mankind.

For example, coal has been discovered in the region of equatorial Africa to which Carl Akeley sailed last August. This is the first good coal found in Africa. There are small lignite deposits farther south, but the lack of a suitable smelting coal has forced African miners in this region to float copper and zinc ore down the rivers to the coast and to ship this unnecessary bulk of ore across the sea for reduction. Now, in an area of which very little was known, we have found a coal-mine which will do much to make this section of Africa a great producer of metal.

A parallel case exists in British Guiana. The streams here have some gold in their sands, and occasionally placer-miners find a diamond. But where are the diamond "pipes"? An expedition has left the Smithsonian to look for mines, and its leader, W. J. Lavarre, expects to remain in the jungles until he succeeds in this quest.

Geographical explorations such as Shackleton's and Colonel Bury's expeditions to Mount Everest, is drawing to a close. They have become a matter of clearing up details rather than preliminary surveys of totally unknown regions. The era of commercial exploration, such as the expedition of Lavarre and the oil prospecting on the Mackenzie have only begun, and in the future we can expect more and more work of this character. For instance, a few of the expeditions in the field to-day for scientific objects are the following: Dr. C. D. Walcott in the Canadian Rockies, Mr. L. H. Abbott in Chile, Dr. H. L. Shantz in Africa, and Mr. C. M. Hoy in Australia. The majority of modern exploration is purely scientific, but it must not be supposed that this "pure science" has no interest for the average man. It might seem as if the discovery of ten new varieties of beetle in South America, is a matter of little practical importance. But results which are at first "purely scientific" soon turn out to be of immense practical importance. Dr. Henry Rusby is now in the Amazon valley in search of rare plants—and to study noxious insects. Among the plants he expects to find medicinal remedies unknown to our present pharmacopoeia, perhaps a medicine of such tremendous importance as quinine, which was brought back from these same forests by the early Spanish explorers. The study of insects may lead to the discovery of new serums for the treatment of dysentery and lockjaw, or the blotting out of tropical diseases, as his colleagues discovered the causes and the cure of sleeping sickness.

Few of us realize that modern research is like a pyramid—we hear of the peak, the culminating fact, that is recorded in the daily papers, but this is based on a long series of observations and data gathered by men scattered to the ends of the earth, working laboriously and unknown to fame in tropical jungles and frozen wastes. A scientific discovery is a synthesis of apparently unrelated facts gathered by many men, and these modern explorers at work at the points indicated on our map are really the advanced outposts of the army of science, and if the age of exploration for its own sake is drawing to a close, that of exploration for the sake of humanity has only begun.

GIVE Popular Science Monthly for Christmas

A SPECIAL HOLIDAY PRICE TO OUR READERS

An ideal Christmas Present will be a subscription to Popular Science Monthly. You will give fresh, fascinating, vital reading for a whole year. Popular Science Monthly is packed full of useful facts, new ideas and practical information. Give some friend the pleasure of having this good magazine, which is growing better every month.

We make you a special Christmas rate of \$2.50 for a year's subscription. This special rate is open to every reader.

\$2.50 the Christmas Rate on Popular Science Monthly

You may give one or more subscriptions at this special rate. You also may include your own subscription. Use the order blank below. If more convenient, you may remit after January 1st, but send your order now. This offer expires December 25th.

Every Month Next Year All These Things in Popular Science Monthly

What Do You Want to Know?

Popular Science Monthly will answer your questions free of cost.

Useful Things to Do at Home

First aid hints for keeping things shipshape about the house.

Every-Day Wonders

Ten fascinating facts of science explained in every issue.

Things to Make with Tools

Over 50 new designs every month which every reader can make at home.

Your Automobile

Latest facts on economy of upkeep—repairs—tires—motor—gas—oil—batteries—garage—new accessories.

New Inventions

New tools, new labor-saving devices, wonderful new machines—hundreds in every issue.

Flying

Watch this marvelous science grow month by month.

Send Christmas Order Blank Now

POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York

Enter subscription for Popular Science Monthly for 1922 for the name below.
Please send Gift Card Announcement.

Send to _____

Ordered by _____

Address _____

Address _____

You may write order on blank paper if
you prefer

Check here if you wish to include your
own subscription

Amount \$ _____

Remittance
herewith

Please send
bill

Guaranteed Genuine Leather 98¢



**23-Karat Gold Name
Engraved Absolutely FREE**

(City 30c, Street No. 30c, Fraternal Emblems 40c Extra)
This attractive engraving gives the pocketbook an exceptionally rich and handsome appearance. This work alone is worth \$1.50 of anybody's money.

Send No Money

Don't send us a penny in advance. Just send your name and address on the coupon and tell us what you wish engraved on the pocketbook. Then when you actually receive it, simply pay the postman our remarkably low price of 98¢ and postage plus extra charges as shown if you want address, etc. If you are not delighted and if you don't think this is the best book you ever made, return it to us and we will refund your money at once, including postage. We have been selling these pocketbooks for over 10 years. You take no risk! Send coupon today!

U. S. Leather Goods Co., 106-110 W. Lake Street, Dept. 1788 Chicago, Ill.
Send me your Genuine Leather "American Bankroll" 1921 model pocketbook. When it arrives I will pay the postman your special price of only 98¢ and the few cents postage, plus extra I have checked below. If I am not more than satisfied I will return the pocketbook and you will return my money, including postage.

Name Engraved Black Brown

St. No. 30c extra

City State 30c extra

Emblem 40c extra
Be sure to check color of pocketbook, and engraving you wish in addition to your name.

Stars of Popular Music Play the Conn



What greater proof of superiority than the fact that these artists and their orchestras all use Conn instruments? Yet these are only a few of those who, personally and through phonograph records, are thrilling millions with the brilliant beauty of their music.

You, too, can win popularity, double your income, playing whole or part time in band or orchestra. Take a tip from the world's greatest artists; play a Conn. Exclusive processes make them easiest of all to master.

Free Trial; Easy Payments

All exclusive Conn features at no greater cost. Highest honors at world expositions. Used in great concert and symphony organizations.

FREE BOOK "Success in Music and How to Win It" by Sousa and nine others. Send coupon for your copy and details of free trial offer.

Conn Ltd.
1232 Conn Bldg., Elkhart Ind.
Agencies in all large cities
New York, Conn Co. 233-3-7 SU 47-54

An Ideal Christmas Gift

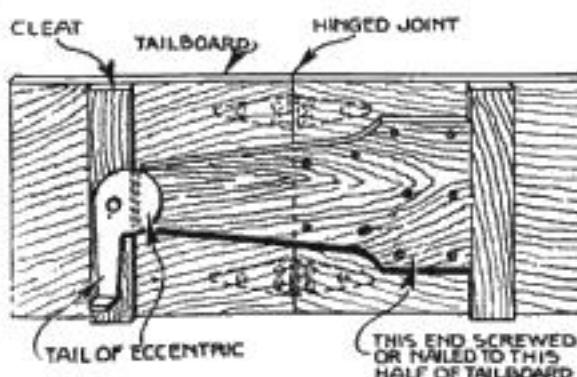
C. G. Conn Ltd., 1232 Conn Bldg., Elkhart, Ind.
Gentlemen: Please send my copy of "Success in Music" and details of your free trial plan.
(Mention Instrument.)

Name
St. or Rural Route
City, State
County
Instrument

THE HOME WORKSHOP

Hinged Tailboard with an Eccentric Lock

If you are handy with tools, you can construct a hinged folding tailboard with an eccentric lock such as the one shown in the illustration. The lock is cut



Interesting suggestion for a hinged tailboard with an eccentric lock

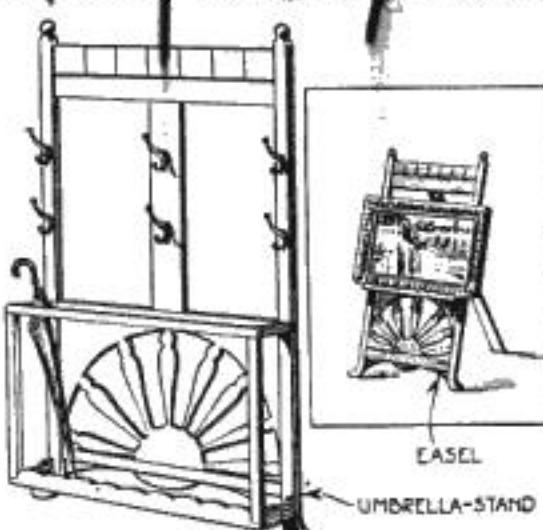
from a piece of flat iron stock, the lower end (or tail) being bent slightly outward to provide a handle.

The locked position of the eccentric is shown, the weight of the tail portion normally holding it so. When the tail is turned straight up, the catch of the lock is released, and the tailboard can then be removed.—LOUIS SCHNEIDER.

Hallstand Is Built from an Old Oak Easel

A N antique oak easel that had stood in the attic for a long time, was transformed into a hallstand as illustrated.

The stick at the back that supported the easel was cut into lengths for the umbrella-rack, together with the strip on which the



This illustrates the transformation of an antique easel into a modern and useful hallstand

picture rested, the scalloped portion of which made edges for the bottom of the rack, which was the only new piece of wood required, and was stained with a dark oak finish to match the rest. Six ornamental brass hooks were added, and the result was a good-looking and useful article of furniture.—KATHERINE L. DANIHER.

Try a Coal "Carburetor" on Your Range

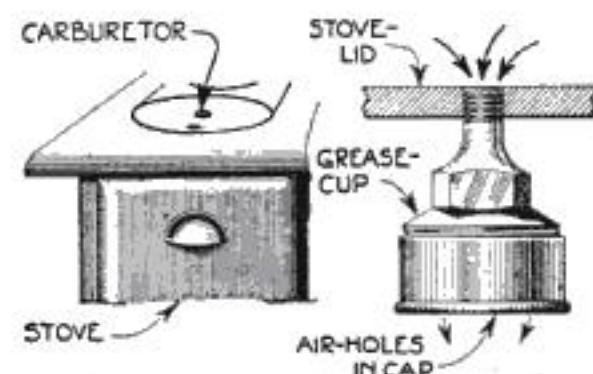
THE object of the device is to save coal, which it does by mixing the gases created in combustion with air and burning them, instead of permitting them to go to waste up the chimney.

Manufacturers of several patented "carburetors" claim a saving of at least 20 per cent in the amount of coal used, besides

complete combustion, giving a uniform heat, and burning the coal to a fine white ash without clinkers.

The one shown in the illustration has been thoroughly tested by several months' use on a kitchen range, and has given exceptionally good results. To make one, all that is needed is an old grease-cup (iron or pressed steel) from an automobile, such as is used on the Ford universal joint, two small drills, and a $\frac{1}{4}$ -in. pipe-tap.

Drill a hole in the center of the stove-lid and tap a $\frac{1}{4}$ -in. pipe-thread in it. Take



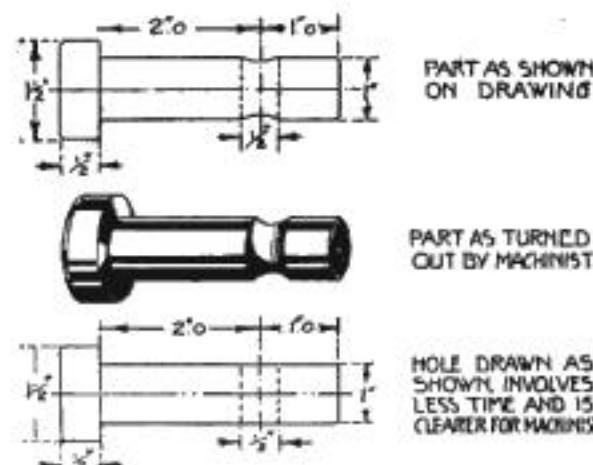
Try this coal—"carburetor" on your range and you will find that it saves coal

the top of the grease-cup and with a very small drill (1/60) drill, evenly distributed, about a dozen holes in it. Screw the cup together, and then screw it into the tapped hole in the stove-lid. Your "carburetor" is now complete and ready to work; hanging inverted over the fire. Even better results can be achieved by attaching a carburetor to each lid that is directly over the fire.—E. B. DEISTER.

Correct Drawing May Cause Error in Machining

OWING to the manner in which a circular drilled hole was shown on a detail drawing, as being cut through a circular bar, a machinist was misled to the extent of turning out a piece with a circular groove around the bar instead of the required hole. While the method of depicting a hole in the bar is correct as shown in the illustration, in accordance with mechanical drawing practice, also the dimension or the diameter of the hole, these details will invariably mislead the mechanic if he does not understand the projection.

A method for the draftsman that involves less work and is clearer to the ma-



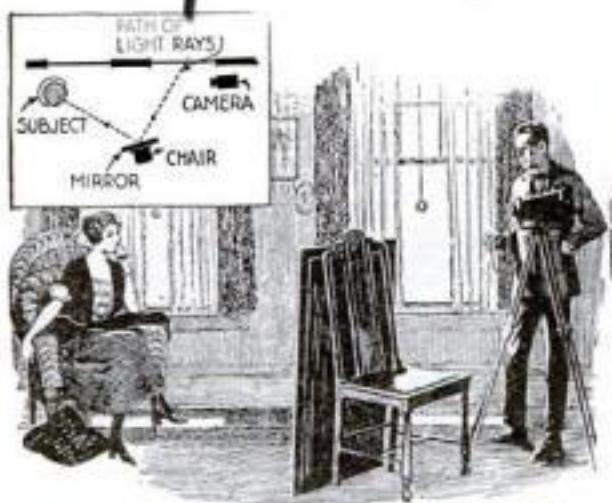
Draftsmen can learn from this illustration how to make their drawings so that they cannot be misread

chist is to leave off the circular lines at the ends of the holes. As a time-saver and for clearness, this is worth adopting.—G. A. LUERS.

THE HOME WORKSHOP

How to Obtain Reflected Light for Indoor Pictures

THE amateur photographer finds that taking interior pictures by daylight is not usually a success. The ordinary living-room does not furnish sufficient light for photographic purposes, even when a time exposure is used. The only method is to place the subject close to a window so as to get the full benefit of the light. However, this always results in having one side



Amateur photographers will be able to take an indoor portrait by the use of this simple arrangement

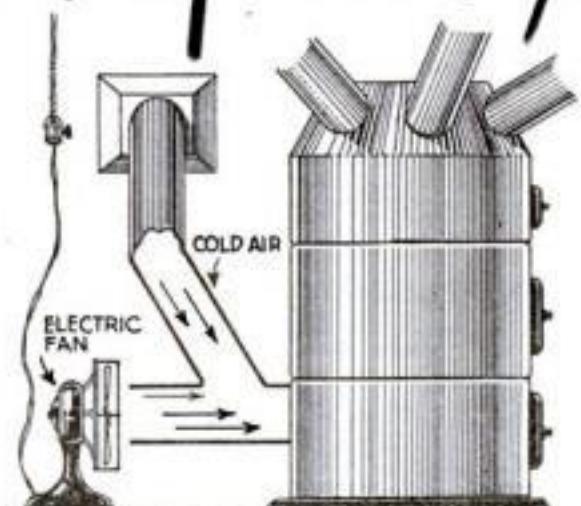
of the object illuminated, while the other side will be in the shade. This difficulty of proper lighting has caused many a camera lover to avoid indoor pictures.

By the use of a mirror properly placed, some of the light coming from the window may be reflected to illuminate the shaded side and thus help to procure more even lighting and avoid the defect of heavy shades and shadows. An ordinary sized hanging mirror so used will give surprisingly good results. A large piece of white paper with a glazed surface will make a good substitute for the mirror.

The picture and inset diagram show the arrangement. The best location and angle of the mirror can easily be determined by trial.—B. Fox.

Another Winter Use for an Electric Fan

An electric fan need not be stored away in the winter time, as it can be put in service in the way shown in the picture. It is connected with the cellar light-socket



The electric fan forces cold air into the furnace, thereby aiding fuel combustion

and placed so that it will blow air into the cold-air pipe. This assists the circulation of cold air through the furnace, aids the combustion, and increases its heating efficiency.—JOSEPH B. MORAN.



Harry K. Phillips Chief Chemist Pine Tree Chemcraft Chemist Club has a message for you.

"If you want to get something that will keep you busy and fascinated all the time; that will show you the wonders of chemical science; that will start you off on one of the most interesting things you ever did; that will give you reliable and practical information on the most absorbing science there is to-day—if you want REAL fun with a live bunch of fellows—then I say to you, get a CHEMCRAFT outfit and start experimenting on your own hook!"

"With a CHEMCRAFT outfit you can work all kinds of amusing and instructive chemical experiments. You can test the things you eat, wear, and use every day; make soap, dyes, inks, and do many other practical and useful experiments that will be more fun than anything you ever did, and give you an understanding of chemical science. Yes, you can do fine tricks, too, the kind that make everybody wonder how you do them. Chemical experimenting is the finest sport I ever had. Everybody says my "lab" is a dandy, and it started with a CHEMCRAFT outfit. When I got my outfit I joined the Chemcraft Chemist Club and started my own Local Chapter under the "Pine Tree" name. Now I've got a live Club and I'll soon have a real business, too. I'll tell everybody that the best thing I ever did was to get my CHEMCRAFT outfit—and I advise every boy to get one right away."

REGISTERED TRADE MARK
CHEMCRAFT
THE CHEMICAL OUTFIT

Makes Any Boy an Amateur Chemist!

You can do what Harry has done. A CHEMCRAFT outfit is your introduction to the "wonders of chemical science", as Harry says. Plan now to get your outfit this Christmas. Then you can join the Club; be the Chief Chemist of your own Local Chapter, and get other boys in with you. You'll get the Club magazine, too,

CharacterCraft
The Character Analysis Game

Makes Character Reading Easy and Interesting for Children and Adults

Based on the celebrated character analysis science of Dr. Katherine M. H. Blackford and is correct in principle. Outfit contains eye, nose, mouth, chin, forehead and head sections; both profile and front views; with which thirty-nine thousand six hundred different faces and heads can be formed. Book of instruction included. Practical character readings can be made by anyone, and in accordance with Dr. Blackford's scientific observations. Very interesting and instructive for children and grown-ups, and the youngsters can play an absorbing game with it. Complete outfit, in strong box

\$3.00

(West of Denver, Colo., and in Canada, 10% more)

Special Note to Fathers, Uncles, Big Brothers and all Good Friends!

If you want to make your favorite youngster happy, give him a CHEMCRAFT outfit. You'll be doing him a real service and start him off on one of the most interesting and practical things he ever tackled. CHEMCRAFT is scientifically correct and is more than a toy. It is a most useful and sensible thing to give him. The boy will agree with you—ask him and see!

Free to Boys Who Write at Once!

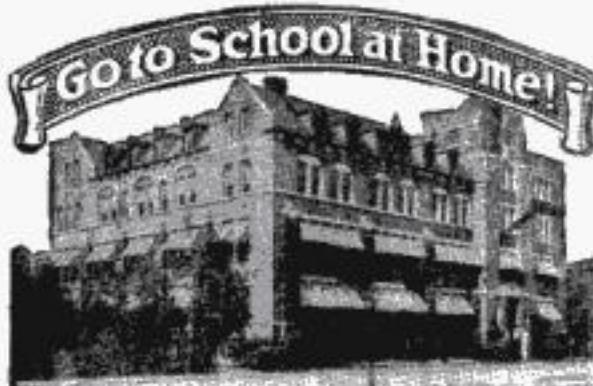
An interesting book telling about all Porter Products, and a copy of the Club Magazine full of interesting stories about amateur chemists, dandy chemical experiments and Club news.

THE PORTER CHEMICAL COMPANY

Porter Products Put Science at Your Service

Industrial-Arcade Building

Hagerstown, Maryland



HIGH SCHOOL COURSE IN TWO YEARS

You Want to Earn Big Money!

And you will not be satisfied unless you earn steady promotion. But are you prepared for the job ahead of you? Do you measure up to the standard that insures success? For a more responsible position a fairly good education is necessary. To write a sensible business letter, to prepare estimates, to figure cost and to compute interest, you must have a certain amount of preparation. All this you must be able to do before you will earn promotion.

Many business houses hire no men whose general knowledge is not equal to a high school course. Why? Because big business refuses to burden itself with men who are barred from promotion by the lack of elementary education.

Can You Qualify for a Better Position?

We have a plan whereby you can. We can give you a complete but simplified high school course in two years, giving you all the essentials that form the foundation of practical business. It will prepare you to hold your own where competition is keen and exacting. Do not doubt your ability, but make up your mind to it and you will soon have the requirements that will bring you success and big money. YOU CAN DO IT.

Let us show you how to get on the road to success. It will not cost you a single working hour. We are so sure of being able to help you that we will cheerfully return to you, at the end of ten lessons, every cent you sent us if you are not absolutely satisfied. What fairer offer can we make you? Write today. It costs you nothing but a stamp.

AMERICAN SCHOOL

Dept. H-975, Drexel Ave. & 58th St., Chicago

American School

Dept. H-975; Chicago, Ill.

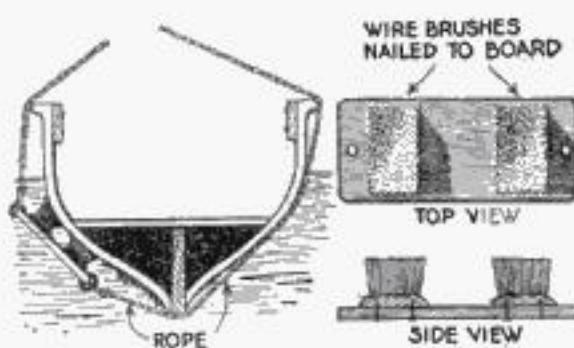
Explain how I can qualify for position checked:	
Architect \$5,000 to \$15,000	Lawyer \$5,000 to \$15,000
Building Contractor \$5,000 to \$10,000	Mechanical Engineer \$1,000 to \$10,000
Automobile Engineer \$4,000 to \$10,000	Shop Superintendent \$3,000 to \$7,000
Automobile Repairman \$2,500 to \$4,000	Employment Manager \$4,000 to \$10,000
Civil Engineer \$5,000 to \$15,000	Steam Engineer \$2,000 to \$4,000
Structural Engineer \$4,000 to \$10,000	Foreman's Course \$2,000 to \$4,000
Business Manager \$5,000 to \$15,000	Sanitary Engineer \$2,000 to \$5,000
Certified Public Accountant \$7,000 to \$15,000	Telephone Engineer \$2,500 to \$5,000
Accountant & Auditor \$2,500 to \$7,000	High School Graduate In two years
Draftsman & Designer \$2,500 to \$4,000	Fire Insurance Expert \$3,000 to \$10,000
Electrical Engineer \$4,000 to \$10,000	
General Education In one year	

Name _____ Address _____

THE HOME WORKSHOP

How to Clean the Under Part of the Boat Hull

A PRACTICAL method of cleaning the hull of a boat without hauling it out of the water is shown in the illustration. This device consists of two or three wire



Use this scrubbing-brush when you clean the bottom of a boat. It can be done without taking the boat from the water

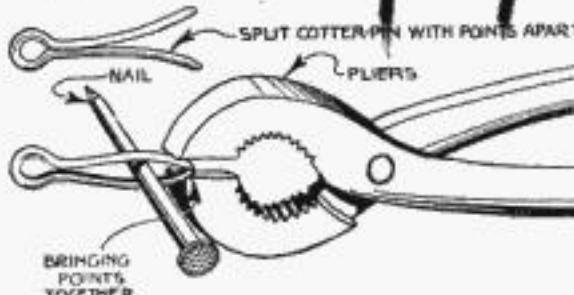
brushes fastened to a plank with a rope at each end of the plank. This is let down over the bow or stern of the boat and the owner or cleaner pulls this back and forth from above by means of the attached ropes.

All of the marine growths, barnacles, etc., can readily be removed. The purpose of cleaning is, of course, to prevent decay and obtain better speed with the boat, as these accumulations hinder the boat's progress through the water.—G. A. LUERS.

Straightening Cotters to Bring Points Together

IN order to insert a cotter-pin into a cotter-pin hole after the ends are once spread, loss of time ensues unless the points are brought together.

The wavy ends will stand open unless



This little kink is a good trouble-saver, especially for the mechanic

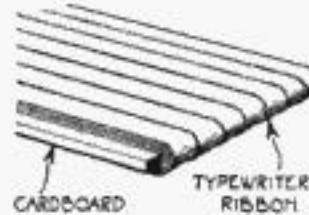
they are bent in the opposite direction. To do this, place a nail between the points and press them together with the pliers.

Stamp-Pads May Be Made of Type Ribbons

OLD typewriter ribbons form very satisfactory rubber-stamp pads.

Take a suitable length of discarded ribbon and wind it around a piece of cardboard, cut to fit the pad-box easily. Arrange the loose end underneath, and secure with a drawing pin or small tack, and place in box.

The top layer can be cut away instantly when clogged with dust and dirt, exposing the clean inky surface beneath.—GEO. H. HOLDEN.



Save up your old typewriter ribbons and make this practical inking-pad

Write as You Pay Very Easy Terms

Sent On Trial

Save
\$30.00

DIRECT
TO YOU
AT ROCK
BOTTOM
PRICES.



A Remarkable Typewriter Bargain.

Why pay rent when you can own outright a brand new improved Harris Visible Typewriter by making small monthly payments? The Harris is an up-to-date, efficient and durable full standard size business typewriter. Has universal keyboard. Full visible writing. Silent and speedy action. Built of the best materials and fully guaranteed by us. Over 1,500 Harris Typewriters are in daily use in our offices under the most severe service conditions.

Send for Free Harris Catalog.

Write today for Harris Typewriter Catalog No. 91P88A. It tells all about this wonderful machine.

Sears, Roebuck and Co., Chicago

I'm glad I said PARKER

Fountain Pen



LUCKY CURVE



LEARN AUTOS AND TRACTORS

Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

7000 graduates making good. Catalog Free.

Cleveland Automobile School, 1821 E. 24th St., Cleveland, Ohio.

Deafness



Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relaxed or Sunken Drums, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

Wilson Common-Sense Ear Drums

"Little Wireless Phones for the Ears" require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are invisible. Soft, safe and comfortable.

Write today for our 168 page FREE book on DEAFNESS, giving you full particulars and testimonials.

WILSON EAR DRUM CO., Incorporated
178 Inter-Southern Bldg. LOUISVILLE, KY.

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made \$30.00 the first day." Others average \$200 to \$300 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

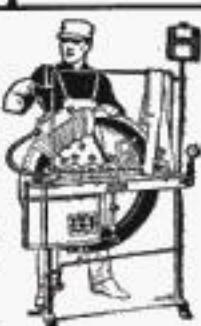
Improved Wrapped Tread Method
Used by Tire Manufacturers

Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercut or overheat a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2111 Fourth St. Waukesha, Wisconsin



THE HOME WORKSHOP

Pulling Posts Is Rendered Easy by This Method

A U-SHAPED staple of heavy iron or steel is driven into a post near its base. If a rock or a log is now placed near the post, and a long pole or an iron pipe is placed on the rock and under the staple, sufficient leverage will be exerted to pull up the post. The staple has greater resisting power to bending when driven far into the post, than one or two spikes of the same thickness. Where a simple spike will bend under the strain, this U-shaped staple will not.

Such a staple can easily be made from odds and ends found in the junk-box. If it



One man can pull a post by this method. Try it and see how easily it will work

is undesirable to bend one, one can undoubtedly be made from some broken pieces of machinery or tools with the aid of a file.—E. BADE.

To Prevent a Saw from Sliding to the Ground

WHEN a man has considerable sawing to do, whether it is regular carpentry work or trees and branches to cut down in the woods, the ordinary sized saw must frequently be laid aside.

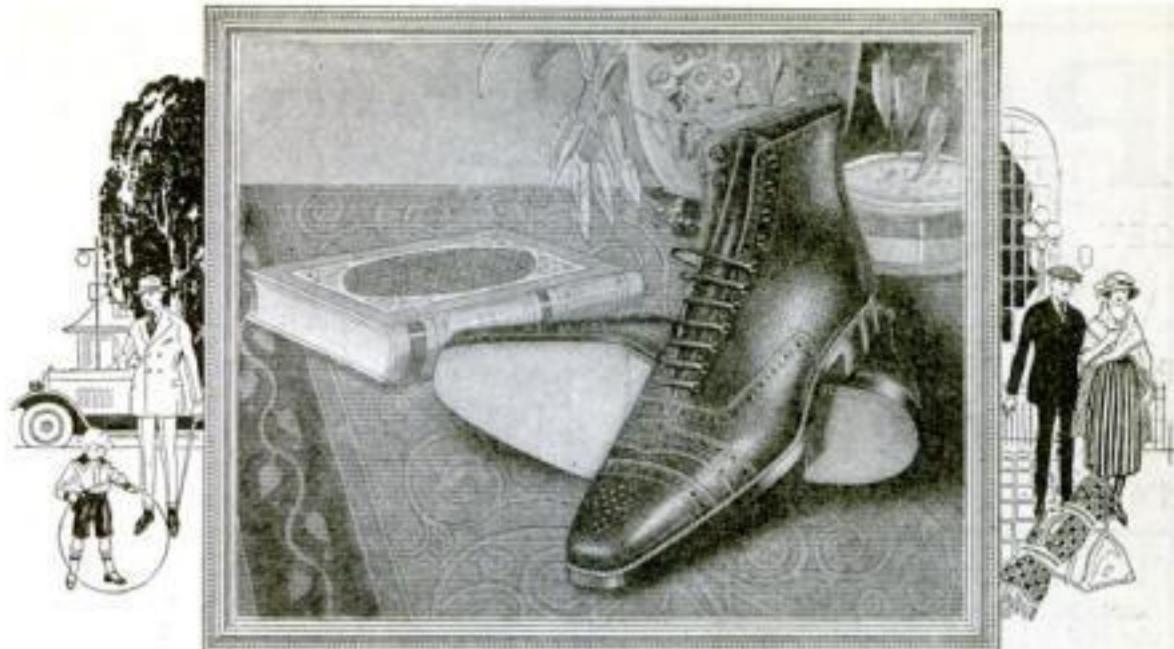
On resuming the work, the saw is picked up from the ground, which necessitates



When a saw falls, the teeth are apt to be injured. File these prongs on the end of your saw and lengthen its life

bending down, as often no place is available to put it on a higher elevation.

This constant stooping on a job that may last for hours is very trying and causes much fatigue. Invariably, when one attempts to stand the saw on end near the job, it will slide and fall. By cutting a V-shaped projection at each end, as seen in the illustration, the saw will stand up without sliding.—ANTHONY E. ZIPPYRICH.



The Fesler—Style M-73

TO the man who enjoys the finer, better things in life, The Florsheim Shoe affords quality of unusual excellence and style that is pleasingly correct, at a cost that is low for the satisfaction received.

The Florsheim Shoe—\$10 and \$12
Photographic Booklet "Styles of the Times" on request

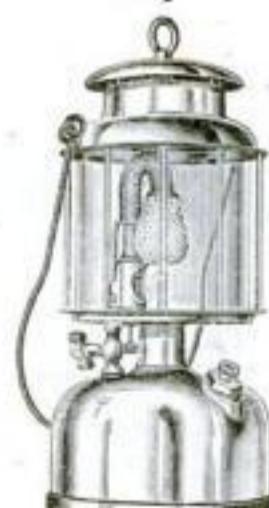
THE FLORSHEIM SHOE CO.

Manufacturers

Chicago

**Make \$15 to \$25 a Day and be happy doing it!****GET a job you can't lose!**

You can make \$90 to \$150 a week as District Sales Manager for the Wizard Kerosene and "Quicklit" Lamps and Lanterns—if you can qualify! We want men who are capable of doing big things—and of earning big money right now. The Wizard Kerosene and "Quicklit" Lamps and Lanterns are the only sure lamps and lanterns that always give all the light that is needed—never get out of order—cannot leak, explode, catch fire. "Quicklit" burns gasoline; lights with ordinary matches. Give more and longer light for less fuel. Only lamps and lanterns made with automatic cleaning needle. Demonstrate these superiorities and you will sell one to a dozen lamps and lanterns a day easily.

**WIZARD LAMPS & LANTERNS**

You can sell direct or through dealers. Build your own business—have a dealer in every town working for you.

We need real men who are able to earn big money. If your time is worth \$15 to \$25 a day, wire or write your application today with full particulars of your ability.

The Nagel-Chase Mfg. Co.
271-275 East Erie St., Chicago, Ill.

The Automatic Cleaning Needle—a new invention—makes them quick sellers



PATENTS

SECURE A PATENT, send for Our Guide Book, **HOW TO GET A PATENT**, sent Free on request. Tells our Terms, Methods, etc. Send model or sketch and description of your invention and we will give our opinion as to its patentable nature.

RANDOLPH & CO.
130 F St., N. W., Washington, D. C.

THE BOY ELECTRICIAN

Practical Plans of Electrical Apparatus for Work and Play with an Explanation of the Principles of Every-day Electricity. \$2.60 Postpaid.

POPULAR SCIENCE MONTHLY, 225 W. 39th Street, New York

IF YOU HAVE AN INVENTION *and DESIRE TO LEARN HOW TO*

NAME.....
STREET.....
CITY..... STATE.....

PATENTS

Booklet Free Highest References
Promptness Assured Best Results

Send drawing or model for preliminary examination of Patent Office records and report as to patentability

All Business Given Prompt and Proper Attention

WATSON E. COLEMAN, Patent Lawyer,
624 F St., Washington, D. C.

PATENT-SENSE

Book for INVENTORS and MANUFACTURERS



SIXTH EDITION

PATENTS

A Hand-Book of Essential Information and Advice relative to Patents, Trade-Marks; Assignment, Sale or Licensing of Rights; Abstracts from Leading Decisions; State Laws on Patent and Trade-Mark Property. FREE! Write LACEY & LACEY

Established 1869
Dept. B, Washington, D. C.



PATENTS

Send us sketch or model for patentability opinion and exact cost of patent. Our book "How to Obtain a Patent" Sent Free on request. It tells how to apply for Patents, Trade Marks, Foreign Patents, Copyrights, etc.; gives information on Patent Procedure; tells what every Inventor should know. Thousands of Inventors, who are our clients, are our references.

CHANDLEE & CHANDLEE, 25 Years' Experience
427 7th St. Washington, D. C.

U.S. PATENTS



DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form "EVIDENCE OF CONCEPTION" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish the same before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request. Ask for them—a post card will do.



274 Ouray Bldg.

WASHINGTON, D. C.

Originators of forms "Evidence of Conception."

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.
Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

201 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c.

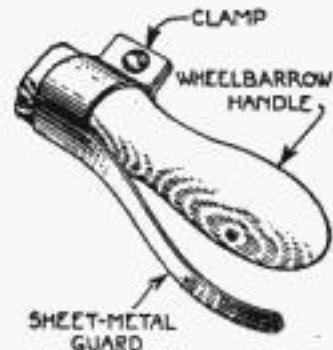
A good use for old books

THE HOME WORKSHOP

Attach a Hand-Guard to the Wheelbarrow

WHEN using a wheelbarrow near a brick wall or fence, the operator's knuckles are often skinned. Also many loads are dumped by the operator in order to save his hands. This means great loss of time.

The guard shown in the illustration will protect the workman's hands. It should be made of iron about 1/16 in. thick, and the part that protects the hand should be comparatively wide. The dimensions can best be calculated to suit the particular conditions.—S. E. GIBBS.



This attachment prevents scraped knuckles

Handy Nozzle on the Hose for Filling Radiator

HERE is an improved way for filling the automobile radiator with water at service stations.

Attach a spring-lever faucet to the end of the hose coupling as shown. The hose can be kept connected with the main all



The spring-lever faucet attached to a water-hose will save time and trouble

the time. All the automobilist has to do is to place the nozzle of the faucet into the filler pipe and then press the lever. The flow of water stops as soon as the finger pressure is released.—L. B. ROBBINS.

Use Old Books for Filing Bills, Recipes, or Pictures

DO not throw away your old dictionaries, atlases, directories, etc. They may be made into holders for filing clippings, recipes, bills, or pictures.

With a sharp-pointed knife cut out pages about $\frac{1}{4}$ in. from the binding. Leave about every fifth page, to separate the various subjects. These pages can be numbered, and an index put inside the front cover of the book. If desired, a thumb index can be cut down the side of the pages so that the required subject may be found quicker.—ARTHUR GOLDENBAUM.



OUR SERVICE IN PATENTS

Our Branch Offices

In order to assist our clients in patent matters and give them the advantage of every convenience and facility, we have established branch offices in New York, Philadelphia, Pittsburgh, Chicago and San Francisco. These branch offices being located in the principal commercial cities of the United States, together with our main office located near the U. S. Patent Office in Washington, D. C., enables us to more promptly handle business of our clients, particularly as the branch offices are in constant touch with the main office, and fully equipped to handle patent and trademark business in all its branches. Our branch offices also enable us to assist our clients in any negotiations regarding the sale or leasing of their patent rights.

SPECIALIZATION — OUR STAFF

The field of invention is so vast that it is impossible for any one man to become an expert in all classes of invention. Only those skilled in the class to which the invention relates are capable of rendering efficient service. For this reason we employ a number of patent lawyers and mechanical experts who have been selected for their special knowledge and ability in certain lines of invention. Each case is placed in charge of an expert in the class to which the invention relates.

THE VALUE OF YOUR PATENT

Will depend upon the skill and care with which your case is prepared and prosecuted in the United States Patent Office. This work will receive the benefit of skill and experience required by long and successful practise. We spare neither time nor pains to secure the broadest possible patents that the invention will warrant. That every case intrusted to us receives our best efforts and that our work is done conscientiously, skillfully and thoroughly is evidenced by the many unsolicited letters that we receive from our clients. We will furnish upon request lists of clients in any state in the union for whom we have secured patents.

OUR THREE BOOKS MAILED FREE TO INVENTORS

We have published three very valuable books for inventors which we will gladly send to you free. They contain very valuable information based upon our experience of over twenty years in patent work. Anyone who has an invention and is interested in proper patent protection, or any one at all interested in inventions should write at once for these three books.

Our Illustrated Guide Book

HOW TO OBTAIN A PATENT—Sent Free on Request

Contains full instructions regarding Patents, Trade-Marks, Foreign Patents, Our Methods, Terms, and 100 Mechanical Movements illustrated and described, Articles on Patent Practice and Procedure, and Law Points for inventors.

OUR TRADE MARK BOOK

Shows the value and necessity of Trade-Mark Protection and gives information regarding unfair competition.

OUR FOREIGN BOOK

We have Direct Agencies in all Foreign Countries. Write for our illustrated Guide Book on Foreign Patents.

SPECIAL OFFER

Free Opinion as to Patentable Nature

We will gladly give you our opinion as to the patentable nature of any invention which you are interested in and urge that you immediately send to us for our "Evidence of Conception" to be signed, witnessed and returned to us, together with model or sketch and description of the invention. Send for this blank form "Evidence of Conception" at once and take advantage of our special offer.

EVIDENCE OF INVENTION

Our blank form "Evidence of Invention" should be filled out by the Inventor before disclosing the invention. The signing of the form "Evidence of Invention," which should be witnessed, legally records the date upon which you conceived the invention which you want to protect with a patent.

WRITE TODAY

Just fill in your name and address and send to the nearest office and we will send you free of charge our patent book as described above.

Highest References Prompt Attention Reasonable Terms

—Free Coupon—

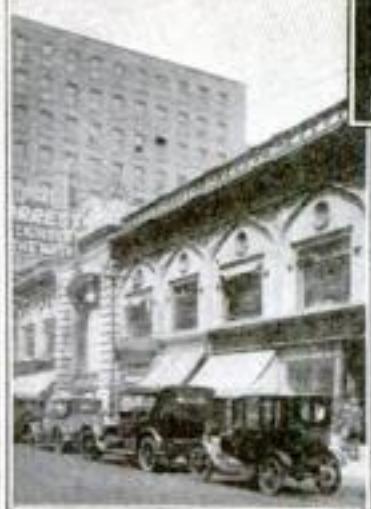
VICTOR J. EVANS & CO.

PATENT ATTORNEYS

MAIN OFFICES, 901 9th St., WASHINGTON, D. C.

Gentlemen: Please send me FREE OF CHARGE your books as described above.

NAME..... ADDRESS.....



Philadelphia, Pa., Office
135 S. Broad Street



Washington, D. C., Office
Victor Bldg.



New York Office
1007 Woolworth Bldg.



Chicago, Ill., Office
1114 Tacoma Bldg.



Pittsburgh, Pa., Office
514 Empire Bldg.



San Francisco, Cal., Office
1010 Hobart Bldg.

Mechanical Engineering



Learn at Home!

Employers are looking for men with mechanical ability.

There is an easy, delightful way in which you can learn right at home in spare time. For 30 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 300 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help.

Let the I. C. S. help you. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least but it will bring you information that will start you on a successful career. This is your chance. Mark and mail the coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 7648-B SCRANTON, PA.

Explain, without obliging me, how I can qualify for the position, or in the subject, before which I mark X.

- | | |
|--|---|
| <input type="checkbox"/> ELECTRICAL ENGINEER | <input type="checkbox"/> CHEMICAL ENGINEER |
| <input type="checkbox"/> Electrician | <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Electric Wiring | <input type="checkbox"/> SALESMANSHIP |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> ADVERTISING MAN |
| <input type="checkbox"/> Electric Car Running | <input type="checkbox"/> Window Trimmer |
| <input type="checkbox"/> Heavy Electric Traction | <input type="checkbox"/> Show Card and Sign Painter |
| <input type="checkbox"/> Electrical Draftsman | <input type="checkbox"/> RAILROAD POSITIONS |
| <input type="checkbox"/> Electric Machine Designer | <input type="checkbox"/> ILLUSTRATOR |
| <input type="checkbox"/> Telegraph Expert | <input type="checkbox"/> DESIGNER |
| <input type="checkbox"/> Practical Telegraphy | <input type="checkbox"/> BUSINESS MANAGEMENT |
| <input type="checkbox"/> MECHANICAL ENGINEER | <input type="checkbox"/> Private Secretary |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Business Correspondent |
| <input type="checkbox"/> Ship Draftsman | <input type="checkbox"/> BOOKKEEPER |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Stenographer and Typist |
| <input type="checkbox"/> Toolmaker | <input type="checkbox"/> Cert. Pub. Accountant |
| <input type="checkbox"/> Gas Engineer | <input type="checkbox"/> Traffic Management |
| <input type="checkbox"/> CIVIL ENGINEER | <input type="checkbox"/> Commercial Law |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> GOOD ENGLISH |
| <input type="checkbox"/> MINE FOREMAN OR RESEUR | <input type="checkbox"/> STATIONARY ENGINEER |
| <input type="checkbox"/> ARCHITECT | <input type="checkbox"/> CIVIL SERVICE |
| <input type="checkbox"/> Architectural Draftsman | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> PLUMBING AND HEATING | <input type="checkbox"/> Textile Overseer or Sup't. |
| <input type="checkbox"/> Sheet Metal Worker | <input type="checkbox"/> AGRICULTURE |
| <input type="checkbox"/> Navigator | <input type="checkbox"/> Poultry Raising |
| | <input type="checkbox"/> Automobiles |
| | <input type="checkbox"/> Banking |

Name _____
Present Occupation _____
Street and No. _____
7-1-21

City _____ State _____
Canadians may send this coupon to International Correspondence Schools Canadian, Limited, Montreal, Canada

Motorcycle Bargains

SAVE 25% to 65%

on Slightly used and Rebuilt Motorcycles, Side Cars, Johnson Motor Wheels, Evans Power Cycles, Bicycles. Send for Free Bargain Bulletin and Money Saving Message, listing hundreds of Bargains in used, rebuilt and new machines, supplies, accessories, etc.

AMERICAN MOTOR CYCLE CO.,
Dept. 1202, 2047 W. Chicago Ave., CHICAGO

MAKE MONEY Building Phonographs

We furnish everything—blue print plans—case material, tone arms, motors, full instructions. You can easily make \$100 to \$200 a month in spare time. Even boys of 14 make them. They play any record. Wonderful tone—equal to any you ever heard. Sell to friends and neighbors. Write now for free blue print offer. Get going for the holidays. Choraleon Phonograph Co. 1221 2d St., Elkhart, Ind.



THE HOME WORKSHOP

Heat Room with Pie-Plate and Gaslight

FOR heating the bathroom or other room when there is no fire in the house, as in the early fall or spring, a device can be made with little expense. The materials needed are a few pipe lengths, joints, an old pie-plate, and a small sheet of asbestos.

The pie-plate is lined with asbestos and is fastened, by means of small pipe lengths



Take the chill from rooms in the morning by using this simple heater

and joints, to the gas-jet. It is fastened in the position shown in the illustration. When the heat from the gas flame hits the asbestos-lined pie-plate, it is reflected downward. The plate should be fastened so that it can be adjusted to any position.

Reference-Book Pages Held with Tire-Tape

PAGES of magazines pertaining to shop-work or papers on some particular subject to be retained for reference purposes are quickly and cheaply bound together with strips of tire tape, as is shown in the attached sketch.

A strip of tape is placed on the back edge of each sheet, overlapping the page to



This shop-notes book will stand a great deal of abuse if put together in the way shown

attach to the strip of tape on the adjacent sheet. When as many pages as are desired are placed together, a sheet of heavy paper or muslin is folded over the book to act as a back.

Whenever it is desired to add pages, the taped pages are separated by pulling away from the tape, and extra sheets with taped edges are inserted.—G. A. LUERS.



Write now for
1922 Basch Diamond Book

Diamonds at Pre-War Prices

Write to-day for the new 1922 Basch De Luxe Diamond Book. Diamonds back to Pre-War Prices. Note these reductions: 1-4 ct. now \$34.50, was \$45.00 1-kt. \$110.00, was \$147.00 1-2 ct. now \$72.50, was \$84.75 1 kt. \$147.50, was \$197.50 We are diamond importers. We sell direct to you by mail at importers' prices eliminating middlemen's profits—36% saved on local store prices. And now with prices slashed to pre-war levels (while retailers are still clinging to big profit prices) you can make additional big savings.

Free Examination—Money Back Guarantee

Every diamond sent on free examination. We take the risk and pay all charges. We also guarantee to refund in cash full price less 10%, if you wish to return your diamond. We allow full price in exchange for another diamond at any time. Every diamond fully guaranteed.

FREE 1922 Basch De Luxe Diamond Book—Write

See the sweeping reductions in this new Basch Book. Rare bargains also in watches, jewelry, silverware, etc. Tell how to judge a diamond. A postcard or letter brings it free—write now.

L. Basch & Co., Dept. B-3897 State & Quincy Sts., Chicago, Illinois

PATENTS

TRADE-MARKS

COPYRIGHTS

Send for our free book
of patent information

Beale & Park

804 F St., Washington, D. C.
16 S. Broad St., Philadelphia, Pa.

PATENTS Secured

Prompt Service. Avoid dangerous delays. Send for our "Record of Invention" form and Free Book telling How to Obtain a Patent. Send sketch or model for examination. Preliminary advice without charge. Highest References. Write TODAY. J. L. Jackson & Co., 169 Ouray Bldg., Washington, D. C.



Make Your Bike a Motorcycle

EASY to do and at low cost. Your old "foot power" bicycle can be quickly transformed to a speedy, easy-running high power Motorcycle with the Shaw Motor Attachment. Fits any men's bicycle of any make or size. Chain drive model can be attached in less than an hour. A boy can put it on. No special tools or knowledge necessary.

SHAW Motor Attachment

Thousands in use. A light weight 2½ H.P. motor of wonderful efficiency. Simple to attach. Everything furnished complete. Every owner enthusiastic. All materials are guaranteed. Get one NOW.

FREE Write at once for Free Book and Low Direct Factory Price on the Shaw Attachment, also the Shaw Motor-bicycle—a complete power machine at a low price.

SHAW MANUFACTURING CO.
Dept. 14612 Galesburg, Kansas

**You Never Need a Gun—until—
YOU NEED IT BADLY**

Get One NOW—Be Prepared

\$14.00 **BAYARD**
Regular Value \$27
AUTOMATIC SHOOTS
COLT'S CARTRIDGES

The "Little Giant," a Midget Automatic. Workmanship is of the very highest grade and equal to any pistol made, regardless of name, make or price. Every detail of design and mechanism the perfection of the pistol-maker's art. Compact. Safety device makes accidental discharge utterly impossible. Made in three sizes, of Blue Steel. Fully guaranteed—money refunded if not greatest value ever offered. Order one NOW! No. 304. (Supply limited.)

Mail Orders Promptly Filled:
Charges prepaid.

We also carry a complete line of Field Glasses, Pistols and Shotguns at extremely low prices.

Satisfaction Guaranteed or Money Back

IMPORT TRADING CO., 258 Broadway, N.Y. City

"DON'T SHOUT"

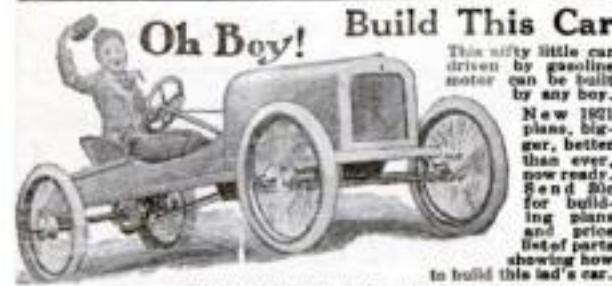
"I hear you. I can hear now as well as anybody. How? With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

The Morley Phone for the **DEAF**

is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless.

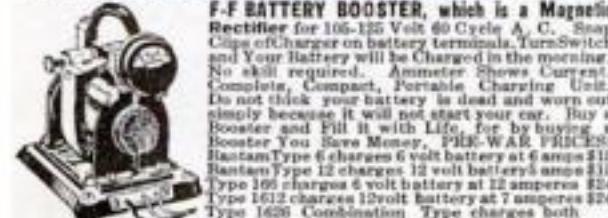
Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.

THE MORLEY CO., Dept. 797, 26 South 15th Street, Philadelphia



SYPHER MFG. CO., 174 Sypher Bldg., Toledo, Ohio

10c CHARGES BATTERY AT HOME WITH AN



THE FRANCE MFG. CO., CLEVELAND, OHIO, U.S.A.
Canadian Representative: Battery Service & Sales Co., Hamilton, Ontario

The Technical or Scientific Book You Need

Turn to our 96-page catalog and find just the book you need on any scientific or practical subject—the latest book by the best author. This is the most complete catalog of its kind issued. You'll refer to it constantly in your work. Only 380 copies remain.

With the catalog will be sent the supplements for 1919 and 1920 and new 32-page book list for 1921. Prices are not yet entirely stabilized, but those in the supplements will be 80% correct. If there is any change in price you will be notified before your order is filled.

Send for catalog to-day. It's free. There will be no obligation for you to buy, and we want you to know our extensive book department.

SCIENTIFIC AMERICAN PUBLISHING CO.
MUNN & CO.

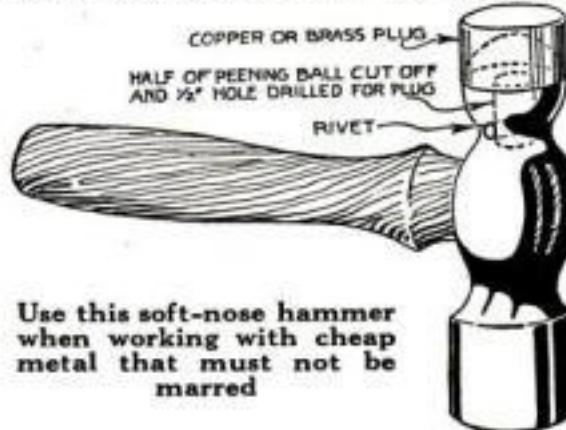
235 Broadway, New York City

THE HOME WORKSHOP

Providing a Soft Nose for the Peen-Hammer

A SIMPLE modification of a ball peen-hammer for purposes of driving in ball-races or for any other use where a brass or copper hammer is required, as on gears, is shown in the illustration.

For this purpose any hammer is suitable, even if the peening end is well worn and



Use this soft-nose hammer when working with cheap metal that must not be marred

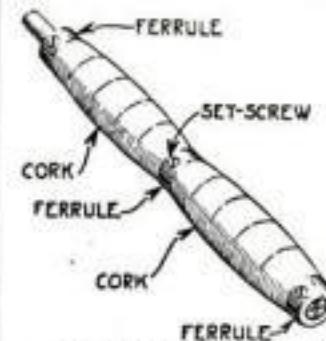
battered, as the ball must be sawed or ground off. A $\frac{1}{2}$ -in. hole is drilled in the end to a depth of $\frac{1}{2}$ in. A copper or brass plug is driven into this hole and held with a dowel-pin drilled through at right angles. The soft brass or copper can be replaced as often as is required.—G. A. LUERS.

A Suggestion for a Cork Handle for Your Fishing-Pole

IF the cork handle on your fishing-pole is worn, below is described how you can make one at practically no expense.

Obtain three ferrules, or steel washers, and a number of large corks. Place one of the ferrules in position, put a few corks over the rod, fasten the second ferrule in place, then a few more corks, last of all finishing up with the third ferrule.

Shape the corks roughly by means of a knife and then sandpaper them to the shape shown. Such a handle is as good as any manufactured style, and is easily applied to any fishing-rod.—J. H. MOORE.

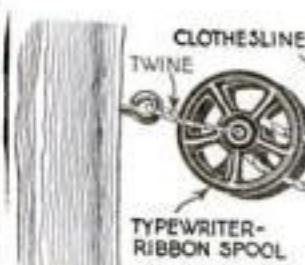


Add to the comfort of fishing by placing this cork handle on your pole

Try This Emergency Clothes-Line Pulley

WHEN a new ribbon is put on a typewriter, there is one roller left over. Don't throw these extra rollers away; they may be useful some day. One use for the old ribbon-holder is to take the place of a broken or worn-out clothes-line pulley.

A piece of twine is put through the hole in the center of the roller and then tied to the hook on the pole. If the knots in the line are too large to pass over the roller, they will either have to be made smaller, or the ends of the rope spliced. —A. GOLDENBAUM.



A new use for an old typewriter ribbon spool

XMAS GIFTS BUY NOW Take a FULL YEAR To Pay

BABE RUTH SAYS:
"I have examined Diamonds in a lot of cities and will say that, for high quality and low price, ROYAL DIAMOND & WATCH CO. can't be beat."

B1—Ladies imported onyx ring, first quality blue white Diamond pierced 14K mounting \$30.00

B2—Ladies 7 Diamond cluster 14K white gold mounting \$45.50

B3—Ladies solid gold ring set with perfectly cut blue white Diamond \$35.00

B4—14K white gold hand engraved mounting, blue white Diamond \$40.00

B5—Ladies 14K white gold hand green gold Lava-settled, set with a perfect blue white Diamond \$55.00

B6—Gentlemen's 14K solid gold Tooth ring, first quality blue white Diamond \$100.00

B7—Hand engraved Twin model solid 14K white or green gold case 15 jewel guaranteed movement \$37.50

B8—Ladies 7 Diamond cluster platinum set resembles \$350.00 solitaire \$57.50

B9—Hand engraved Twin model solid 14K white or green gold case 15 jewel guaranteed movement \$37.50

Pay Next Year for your Christmas Gifts!

ORDER NOW DON'T SEND A PENNY

—goods come to you for examination. Pay (1-5) 20% only if you are satisfied—Take a full year to pay the balance. "ROYAL" diamonds are genuine first quality blue white perfect cut. Every article an exceptional value. All goods sent on approval for 30 days' trial. Satisfaction guaranteed. No references demanded—no red tape—no money in advance. 10% Discount for Cash.

8% yearly Dividends in exchange allowance guaranteed on every diamond purchased from us.

"ROYAL" CHRISTMAS CATALOG FREE

The most complete catalog ever published of Diamonds, Watches, Jewelry, Silverware, Cameras, Ivory Toilet Sets, etc., sent free. Prices the lowest—quality the highest. 30 Days' Trial and a full year to pay on everything you order from our \$2,000,000.00 stock. Send for your free copy today. Address Dept. 417.

Established 1895

ROYAL DIAMOND & WATCH CO.
35-37-39 Maiden Lane New York

MONARCH JUNIOR LATHES

"The Biggest Little Lathe Built"

A STURDY small engine Lathe built with the same quality construction that has made MONARCH ENGINE LATHES standard the world over. An accurate, dependable machine tool especially designed for and guaranteed to do any small work that any other lathe will do with speed and accuracy.

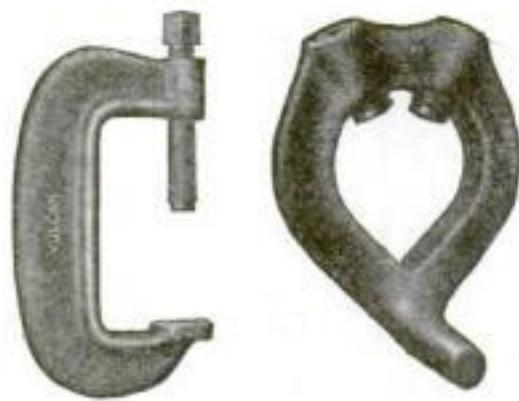
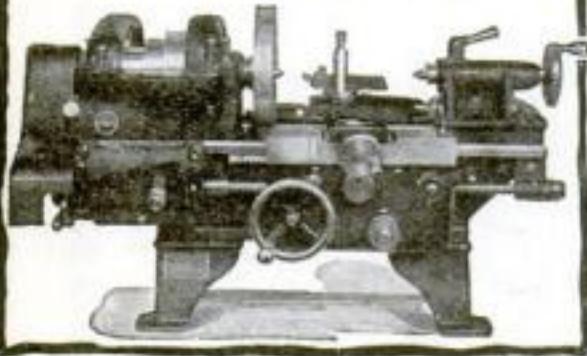
MONARCH JUNIOR will fit in any shop or in a work-room right in your own home. They are especially designed for beginners—are easy to learn to operate and are equipped the same as any larger lathe.

The Greatest Achievement in Lathe Building History

Monarch Junior \$250
9 inch Engine Lathe

Full particulars and a Monarch Junior Catalog will be sent you on request.

The Monarch Machine Tool Co.
201 Oak Street, - - Sidney, Ohio



Strength and Service

Use the dependable, sturdy strength of Williams' Drop-Forged Clamps and Lathe Dogs—they'll never fail you and will last a life time.

Clamps—11 patterns, in a wide range of sizes for every purpose.

Safety Lathe Dogs, Bent or Straight Tail, 1 or 2 screws, 16 sizes.

Ask your dealer—Literature on request.

J. H. WILLIAMS & CO.

"The Drop-Forging People"

BROOKLYN BUFFALO CHICAGO
7 Richards St. 7 Vulcan St. 1007 W. 120th St.

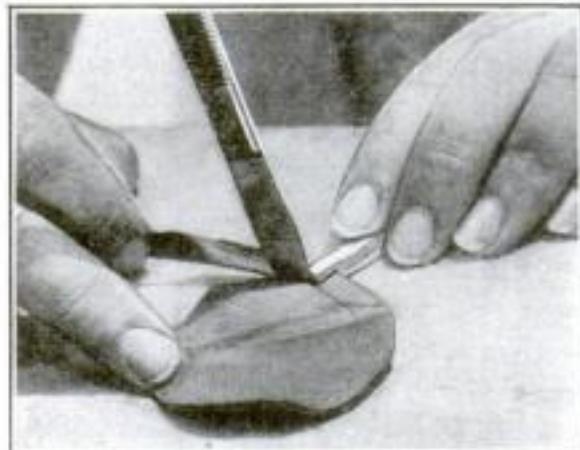
THE HOME WORKSHOP

How Leather Straps Can Be Made at Home

OFTEN it is necessary to have a few lengths of narrow leather straps as belts for model machinery. These can be made easily from any piece of available leather. Before it can be cut into strips, it must be cut into circular form.

The only requisites are a sharp knife and a small piece of wood. The knife should be as sharp as a razor if perfect results are to be obtained. The piece of wood used can be of any convenient size. One side must be perfectly flat, and this side is further prepared by cutting a mortise on one end. This mortise is cut to a depth slightly more than the thickness of the leather and of a width to which the desired strap is to be cut.

Then the knife is firmly driven into a board or into the workbench, and the cir-



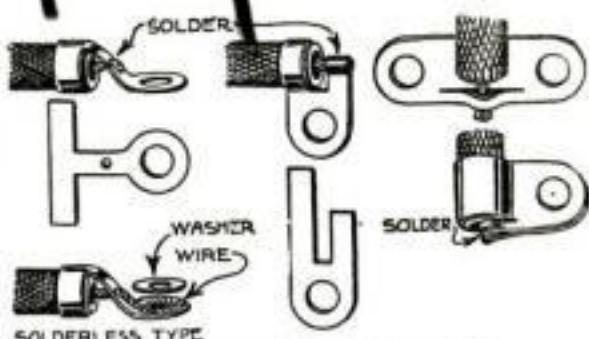
Small leather belts can be made easily when the leather is cut in this way

cular piece of leather placed before the knife. The small piece of wood is placed against the knife, and the leather, which has first been cut a little so that a strip of it can be drawn under the mortise and held in the hand, is then gently but firmly pulled against the knife.

When the leather is pulled, it will be found to press against the mortise cut into the wood, and the knife will cut the leather as it reaches it. The leather will tear when the knife is dull.—E. BADE.

Do You Make Your Own Wire Terminals?

I HAVE seen so many persons use the plain wire ends twisted under the binding-screws of apparatus for connection that I thought I would describe a way of making your own wire terminals. By employing these connectors, there will be better



The amateur electrician will be interested in this suggestion

electrical contact, the wires will not become broken, and the possibility of a short circuit is avoided. These connectors may be cut out of sheet copper or brass.

The illustration shows three types of terminals and does not require an explanation.—A. J. CHRISTOPHER.

AGENTS \$150

THIS IS
A Gold Mine at
ONLY 20 BOXES A DAY MEANS \$15 DAILY PROFIT



"LUCKY 11" Assortment in Display Case

Full size of box 6x13 $\frac{1}{2}$ in. Each article full drug store size. Retail value \$3.35; you sell for \$1.50 and more than double your money. Think of it. The array of fine toilet goods (that always appeals to milady's heart) will dazzle her eye, and when you state the low price of only \$1.50 for these 11 articles, the money is yours, even if she has to borrow or beg it.

Act Now! Sells like hot cakes—men and women could sell "LUCKY 11," 50 other big sellers. Don't delay a minute. Each day's delay means big money loss to you. Sample outfit including Display Case will be sent postpaid for \$1.50. Write for full details. Hurry! Hurry! before it's too late. Act NOW.

E. M. Davis Products Co., Dept. 1369 Chicago

"Lighting Fixtures"

Ready to hang.
Direct from manufacturers.
Completely wired including glassware.

Send for Catalogue No. 20
ERIE FIXTURE SUPPLY CO.
Desk A, Erie, Pa.

MOST POWER—LEAST COST

2 HP. WITTE
PULLS 2 $\frac{1}{2}$
For H.P.—Price—
Quality—the best buy
of all. Costs less than
smaller engines—
more power. Aliases
2 to 30 H.P. Way Down—Cash
or Terms. Lifetime Guarantee.
Catalog FREE
WITTE ENGINE WORKS,
2220 Oakland Ave., Kansas City, Mo.
2220 Empire Bldg., Pittsburgh, Pa.



New Furniture
For Old—
This
FREE BOOK
Tells How

Explains how to refinish old furniture to conform with the vogue for enameled and stained effects—how to make your home artistic, cheery and inviting. Tells how to finish inexpensive soft wood so it is as beautiful and artistic as hard wood. Tells just what materials to use—how to apply them—includes color card—gives covering capacity, etc.

We will gladly send this book free and postpaid for the name of your best dealer in paints. And for 10c we will also send you a can of Johnson's Prepared Wax.

S. C. JOHNSON & SON, Dept. P.S. 2, Racine, Wis.
"The Wood Finishing Authorities"

ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous **BELL ASBESTOS MINES**, in Canada. We also card fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.

For anything you want in Asbestos turn to

Keasbey & Mattison Company

Dept. S-4, AMBLER, PENNA., U.S.A.

Owners of the World's Largest Asbestos Mines



AMERICAN PIPE BENDING MACHINE CO.
51 Pearl Street

BOSTON, MASS.

Complete Conservatory Course by Mail

Wonderful home study music lessons under great American and European teachers. Endorsed by Paderewski. Master teachers guide and coach you. Lessons a marvel of simplicity and completeness. Any instrument Write naming course you are interested in: Piano, Harmony, Voice, Public School Music, Violin, Cornet, Mandolin, Guitar, Banjo or Reed Organ—and we will send FREE CATALOG. SEND for it now! University Extension Conservatory, 408 Siegel-Myers Bldg., Chicago

10 Gallons Gasoline Free

The PaKoT Sales Co., 117 PaKoT Bldg., Kansas City, Mo., will send parcel post paid, to one person in each locality who will use it in his auto, tractor, or gas engine and recommend it, a \$1.00 can of No-Carbon Oil, enough to make 40 Gal. of gasoline take you as far as 50, thereby giving you 10 gallons free. It cleans out carbon and lubricates top piston rings while you drive. Don't send any money. Write for introductory can and it will be sent postpaid.

Get on the Staff of a Big Newspaper

Fascinating work and fine opportunities. Over 22,000 newspapers in U.S.—many with 100 or more writers each. Wide variety of work—reporting—editorial and feature writing—sports—business and financial—theatre and book reviewing, etc. Newspaper men are privileged—admitted where others excluded—always where things are happening—often sent on special trips with all expenses paid—constantly meeting interesting people and seeing the unusual. Good reporters get \$5,000 and up a year. Many newspaper writers make \$10,000 to \$25,000 a year. Now easy to prepare for this big field—veteran newspaper men will teach you by mail in your spare time at home. In a few simple and absorbingly interesting lessons you get the boiled-down know-how of their life-long experience. Free book tells everything—salaries paid—opportunities—how you can quickly yet thoroughly qualify for any branch of the work—how it opens the door to magazine and motion picture writing, and to other opportunities—how little it costs—how we will aid you in securing a good position. Book points way to big things—absolutely free—write today!

Newspaper Training Assoc. Dept. 44, 1123 Broadway, New York

Cleveland
7th Year

A Safe and Sane Motorcycle

Weighs only 175 lbs. As easy to ride as a bicycle. Simple, dependable, two-stroke motor. Very economical.

Write for Catalogue "S"

Price
\$225

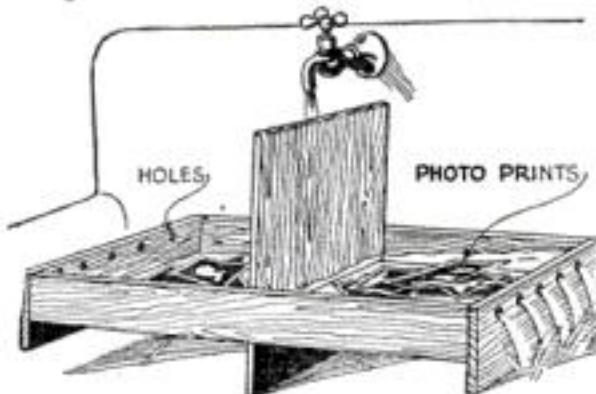
Cleveland
Motorcycle Mfg. Co.
Cleveland, U.S.A.



THE HOME WORKSHOP

This Photo-Print Washing-Box Rocks Automatically

I HAVE used with success the washing-box shown in the illustration for washing photographic prints. It is about 10 in. long, 12 in. wide, and 2 in. deep. The rocker in the middle of box is 1 in. high and



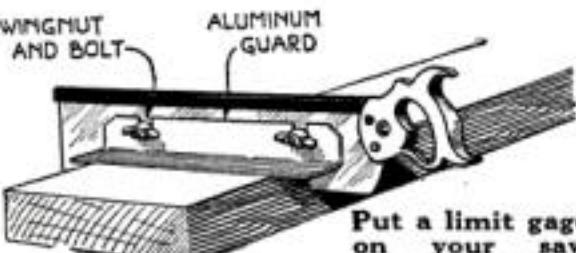
The photographer will not have to watch this washing-tray; it works automatically

bumpers on each end are about 1½ in. The center upright is about 10 in. high and is made so that it is watertight. Half-inch holes centered 1 in. below the top of the box, give outlet for the water. Place prints to be washed in each end and fill with water, place the box under a spigot giving a slow stream of water. As the box fills, first on one side and then on the other, the weight of the water will cause the box to rock as part of the water runs out of the lower end of the box.

Equip Your Tenon-Saw with This Guard

THE guard shown in the illustration consists of a piece of aluminum or other metal bent at right angles, the length and width depending on the saw's length, and the distance from top edge to saw teeth.

Two slots are made about 2½ in. from the ends. A couple of ¼ in. holes are likewise



Put a limit gage on your saw when sawing uniform grooves

drilled in the sawblade to admit small bolts. They are secured with wing-nuts.

After determining the depth of cut required, adjust the guard in position, and tighten the screws.

I find this device especially useful in cutting dovetails; the depth of cut always being equal, measuring is not necessary.

The accessory is attached or detached in a second; it may be applied on either side of saw, and does not interfere with its use for all-round work.—GEORGE H. HOLDEN.

Furniture Polish Renews Old Auto Window Lights

WINDOW lights that are hard to see through because of blurs and scratches can be quickly cleared up by rubbing them with a soft rag saturated with furniture polish. Simply rub them well and wipe off the dirt with a dry cloth and they will shine.—J. C. OTTOFY.

SARGENT



When work is play

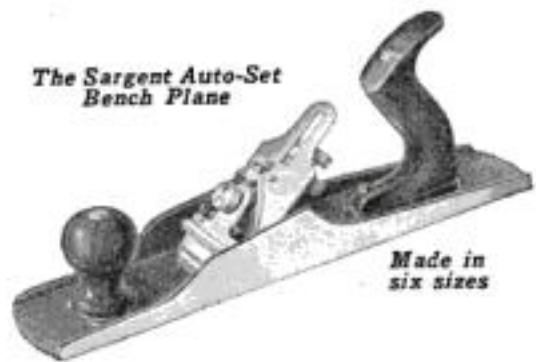
Those odd jobs around the house become good fun when you have a Sargent Auto-Set Bench Plane, and your work will all have a professional finish. Sargent Planes are a favorite among good carpenters; they are ideal for home use.

The Auto-Set feature enables the blade to be removed, sharpened and replaced without readjustment—a feature found only on this plane. It saves your time and temper.

Ask your hardware dealer to show you a Sargent Plane. If you will send us your name and address, we will send you the Sargent Book of Planes without cost.

SARGENT & COMPANY
Hardware Manufacturers
50 Water St., New Haven, Conn.

The Sargent Auto-Set Bench Plane



SARGENT

LOCKS AND HARDWARE

NEW KIND OF HEAT!

Try It in Your Stove 30 Days Free

The OLIVER Oil-Gas Burner keeps home warmer. Three times the heat. Does away with coal and wood—cheaper. Makes your stove or range an oil-gas stove. No fires to make. No ashes, dirt, smoke, odor, chopping, shoveling, carrying dirty coal or wood. Saves hours of work. Makes your stove heat or bake better, cleaner, quicker. Doesn't change your stove, simply sets in firebox, easily slipped in or out, absolutely safe. Lasts lifetime. Makes its own gas from coal-oil (kerosene) at small cost. Oil is cheap and getting cheaper. Gives even heat instantly, much or little, by simply turning valve. Fits any stove. Saves money, time, labor, health.

BURNS 95% AIR-5% OIL. FREE attractive book telling all about the "New Kind of Heat," sent you free, postpaid. Also amazingly low introductory-price offer, including 30-Day Trial, if you act quickly. Write today.

OLIVER Oil-Gas Burner & Machine Co., 2007-1 Pine St., St. Louis. Oldest, Largest Mfrs. Oil-Gas Burners in World.

Agents Oliver Agents earn as high as \$500 a month—\$25 a day spare time is easy. Exclusive territory—real co-operation. Write for FREE sample case offer and details. Big season on.

THE HOME WORKSHOP

Cats Can Be Kept Off the Back Fence

If you are annoyed by cat serenaders on the back fence at night, an old Ford induction coil, connected as shown, will give the feline visitor something to remem-



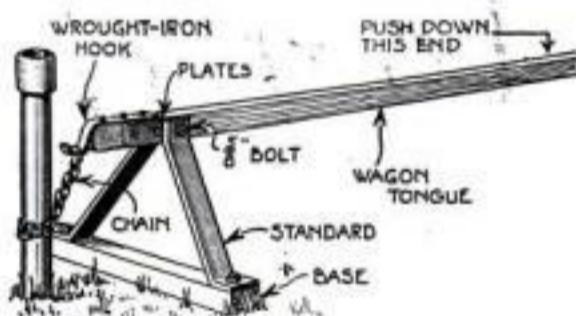
This small electric-shock outfit insures restful nights.

ber. Two bare wires from the secondary of the coil are run along the fence top and when the cat is on the fence it will naturally come in contact with these wires. Closing the switch will cause any cat to leave the vicinity abruptly.—J. B. MORAN.

Pipe-Pulling Tool Is Useful on the Farm

To pull a pipe from the depths of the earth is strenuous work, but here is a tool that will be a sure help.

Get a wagon-tongue and cut it about 8 ft. long. At the large end or butt, screw two steel plates to opposite sides and drill three holes through the plates and timber 6, 9, and 12 in. from the end. Holes should be $\frac{1}{8}$ in. in diameter. Then have a blacksmith forge a large hook with a flat shank



Pulling pipes from the ground is difficult without the aid of a device similar to the one shown.

and bolt this to the top of the tongue so that the hook lays over the end and down.

The standard is composed of three pieces of heavy strap iron bolted together in the shape indicated, with a $\frac{1}{2}$ -in. hole drilled in the top of each bearing to correspond with the holes in the tongue. Then the tongue is pivoted to any one of the three holes by a $\frac{1}{2}$ -in. bolt as a pivot bearing.

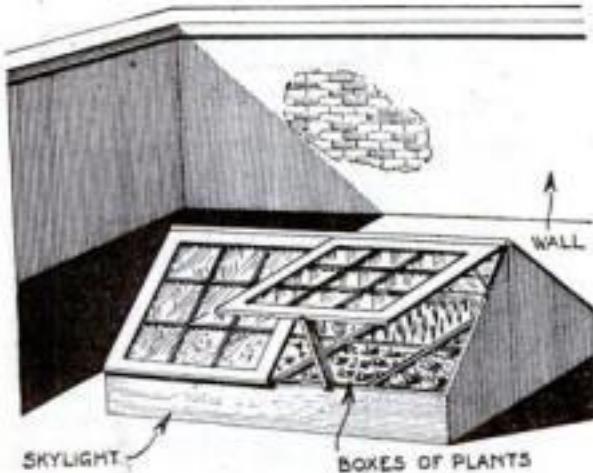
Set this lever so that the hook comes 2 or 3 in. from the pipe and wind a strong chain about the pipe a foot or so below the hook. Pull the turns of the chain tight, so that they bite the iron and hook a link at each end over the hook. This raises the far end of the tongue. Then, by exerting the weight of the body on the end of the lever, with the chain biting good, the pipe will come.—L. B. ROBBINS.

THE HOME WORKSHOP

Skylight Serves City Dweller as a Hotbed

THE foreman of an assembly room had a fondness for gardening. One spring he converted a skylight on top of one of the shop roofs into a temporary hotbed. Supports were placed across the space beneath the glass and in these were set boxes of suitable size in which the seeds were planted. Needless to say, the plants thrived and were ready for eating two weeks sooner than if they had been planted in the open air.

The skylight proved to be particularly appropriate since it faced the south, and was protected on all sides from cutting



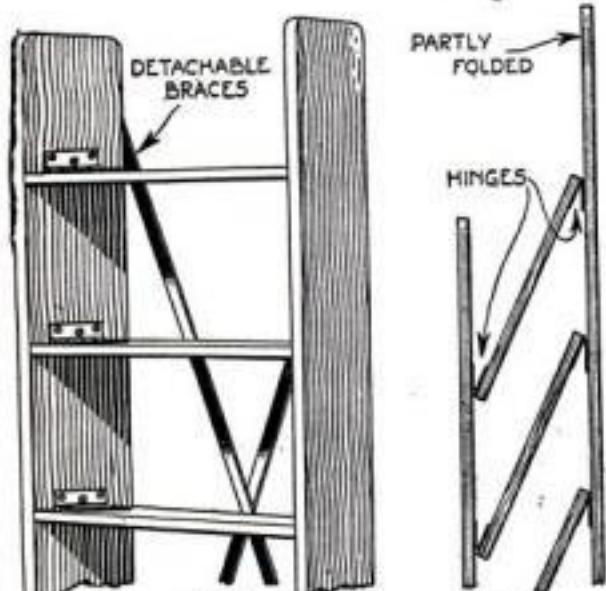
An idea for the city dweller who would like to have a garden

winds by a 6-ft. wall at the edge of the roof. The plants inside were spared any drop in temperature. Moreover, the heat rising from the rooms below helped the germination process.—D. R. VAN HORN.

A Collapsible Stepladder for Home or Shop

STEPS are attached to the uprights by means of hinges. Those on one side are on the upper side of each step; those on the opposite side are screwed to the under side, as shown in the picture. The appliance, when not in use, folds up flat.

The two cross stays are of $\frac{3}{4}$ in. h. $\frac{1}{8}$ in.



steel, secured at the top by a screw, the other end being held in position by a wing-nut and bolt. The stays will then be found to hold the ladder rigid during use.

Out of action, the ladder folds up to occupy a space about 7 ft. long by $\frac{3}{4}$ in. deep.—GEORGE H. HOLDEN.

42-240

New 300 Candle Power Lamp

Make \$60 to \$100 a Week
Introducing this wonderful new lamp. Gives soft, brilliant light; restful to eyes; ideal illumination. Burns Kerosene or Gasoline. Clean, odorless, economical. Burns 96% air, 4% fuel. Absolutely safe. Lights with match. 100 times brighter than wick lamps. Patented. Greatest improvement of age. Table lamps, hanging lamps, lanterns. Work all or spare time. You simply take orders. We deliver by Parcel Post and do collecting. Commissions paid same day you take orders. No experience necessary. Get started at once. Big season now on. Write today for catalog and special agents offer.
THE AKRON LAMP CO.
1612 Lamp Bldg., Akron, O.

BUY A UNION TOOL CHEST ON THE MONTHLY PAYMENT PLAN

Here's a chance to buy a chest to protect your tools—on terms. 50 different styles for every need to choose from.

Pay the Easy Way

Ask for catalog, details of this easy payment plan, and send the name of your hardware dealer. Start now to buy that tool chest you have always wanted and needed to keep your tools safe. Write today.

UNION TOOL CHESTS
for Machinists, Tool Makers, Carpenters, Steam Fitters, Garage Mechanics, Auto Owners, Repairmen, Conductors, House and General Use, and for Fishermen.

UNION TOOL CHEST CO.
24 Mill St., Rochester, N. Y.

WINDOW SIGNS

AGENTS 500% PROFIT

Gold and Silver Sign Letters
For store fronts, office windows and glass signs of all kinds. No experience necessary. Anyone can put them on and make money right from the start.

\$75 to \$200 a Week!
You can sell to nearby trade or travel all over the country. There is a big demand for window lettering in every town. Send for free samples and particulars.

Liberal Offer to General Agents
METALLIC LETTER CO.
433-A No. Clark St. CHICAGO, ILL.

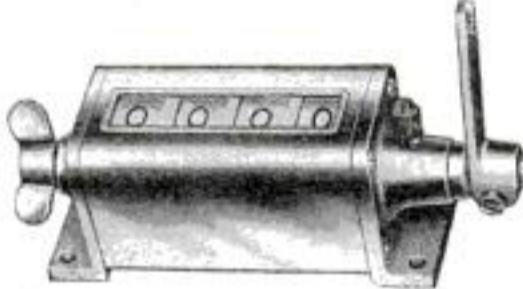
Wheels versus Figure-wheels

You're developing a machine; you may watch the wheels go round and witness the working of parts. But you can't tell as much as by watching the figure-wheels of a Veeder Counter!

You see the machinery at work. Your counter reports the results.

How much *production* per hour or day; how much possible *capacity*; how much *efficiency* secured?—read *that* from a

Veeder COUNTER



The above Revolution Set-Back Counter records the output of any machine where a shaft-revolution indicates an operation. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, \$10.00—subject to discount. Cut less than one-half size. Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, \$11.50 (list). Smaller counters at prices down to \$2.00.

The Hand Tally illustrated below is used for counting anything from number of people attending a ball game, to number of packages in an inventory.

In the public place it counts persons; in the factory or store it counts stock; in the "open" it may count anything from cattle on a ranch, to poles on a telephone line!

Registers one for each pressure of the thumb lever; counts up to 10,000, then repeats. Can be set back to zero from any figure by turning knob once round. Size, exclusive of finger ring, 2 inches greatest diameter. Price, \$5.00.

Write us about that counting problem of yours—there's a Veeder just made for it, and fully described in the free Veeder booklet.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.



Registers one for each pressure of the thumb lever; counts up to 10,000, then repeats. Can be set back to zero from any figure by turning knob once round. Size, exclusive of finger ring, 2 inches greatest diameter. Price, \$5.00.

Write us about that counting problem of yours—there's a Veeder just made for it, and fully described in the free Veeder booklet.

THE HOME WORKSHOP

The Tip-Up for Fishing through the Ice

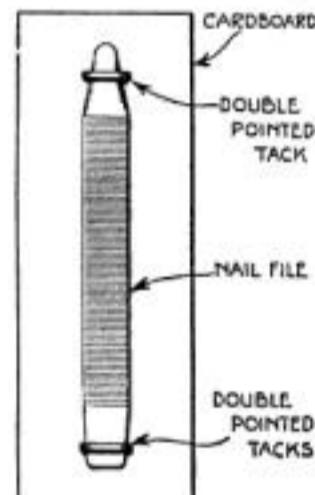
WHEN a fish bites, the tip-up shoots up in the air, announcing that you have made a catch. At once you go to the hole, pull in the fish, and re-bait the hook.

The tip-up is made from a pine board and is about $\frac{1}{2}$ -in. thick throughout, a trifle thinner at both the small and the large ends. It is $1\frac{1}{2}$ in. wide at the small end and 3 in. wide at the large end. A hole is bored through this piece near the small end

and through this a stick is fitted to lie across the hole. To keep the cross stick firmly in place it is well to sink it into a slit in the ice. Water can then be poured around the end. This will keep the stick firm and immovable, no matter how great a struggle the fish puts up.—ROBERT PAGE LINCOLN.

A Finger-Nail File Used as a Match-Scratcher

A DISCARDED nail-file can be made into a very convenient match-scratcher. Cut a piece of cardboard an inch or two wider and longer than the nail-file, place the file on it and fasten the file, together with the cardboard on the wall with two double-pointed carpet tacks. If you wish you may make the match-scratcher more ornamental by placing it on a wooden or metal base and fastening the file in such a manner that it may be taken out to be cleaned and then put back into its place again.—WM. A. JACKSON.

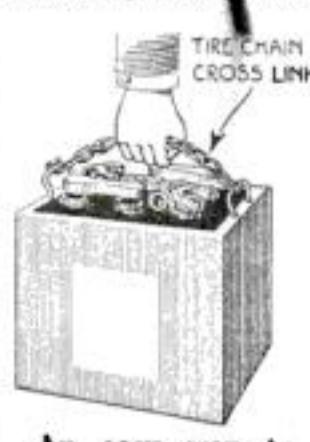


Don't scratch the wall when it can be prevented in this simple way

Carrying the storage Battery with a Chain

ONE of the cross-links from a discarded tire-chain may be utilized to advantage as a handle for carrying the storage battery. Handles made from rope or leather are not satisfactory for any length of time, because they soon deteriorate and then give way under the weight of the battery.

The illustration at the left is self explanatory and clearly shows the manner of attaching the ends of the chain to the handles of the battery box. — WERNER STAAB.



An easy way to carry batteries



"We Can't Keep House Without Sloan's"

WE always keep Sloan's Liniment right where we can lay our hands on it. We use it for every sort of external ache or pain, rheumatism, neuralgia, backaches, stiff joints, sprains and strains."

Sold by dealers you know and can trust.

35c, 70c, \$1.40

Keep it handy

Sloan's Liniment

Pain's enemy

BIGGS Wants FURS

Ship your furs to BIGGS at Kansas City and get **Highest Prices**—quick! No waiting. A fair, square deal to all trappers; honest grading and top prices, always. **No "Commissions" deducted.** BIGGS helps you make more money at trapping, **FREE!** Send name and address today for Free Subscription to "Trappers' Exchange," the finest trappers' magazine published. Also ask for latest fur market reports and "How to Get Traps Free." Write Now!

E. W. BIGGS & CO.
780 Biggs Bldg., Kansas City, Mo.

LEARN ENGINEERING

Electrical and Mechanical Engineers receive fabulous salaries. Thousands wanted. 3 months to 2 years. Practical-Technical training under experts. Not a trade school but a Practical-Technical College teaching electricity, steam, gas, auto-electric, armature winding, drafting. Extensive laboratory and shop equipment. Degrees awarded. Day and night sessions. Enroll anytime. Don't judge us by size of ad. Write for free catalog. FINLAY ENGINEERING COLLEGE, 1022 Indiana Ave., Kansas City, Mo.



New Big No. 15-225 pp. Wireless Catalog

Wireless catalog mailed for 12c in stamps or coin. Any wireless amateur will tell you it is the one catalog to have. As an encyclopedia of information it is invaluable. The largest and most elaborate radio catalog published. Values that cannot be duplicated elsewhere.

THE WILLIAM B. DUCK COMPANY
224-228 Superior St., TOLEDO, OHIO

Gibson Instruments

the "Music Pals of the Nation" easily and quickly enable you to play the music of the day. Delight your friends, increase your popularity, income and pleasure by playing for social affairs, concerts, entertainments, etc. Organize a Gibson Orchestra; we help you receive commission on sales. Small payment, then \$3.00 a month pays for a Gibson. Bring you wholesome year-round entertainment and profit. Gibsons are the recognized world standard. Guaranteed for life.



*Easy to Play
Easy to Pay*

Liberal allowance on old instrument in exchange for a Gibson
Mandolin,
Mandola,
Mandocello,
Manda-Jazz,
Guitar,
Harp-Guitar,
Mandolin-Jazz,
Tenor-Jazz,
Cello-Jazz,
Guitar-Jazz.

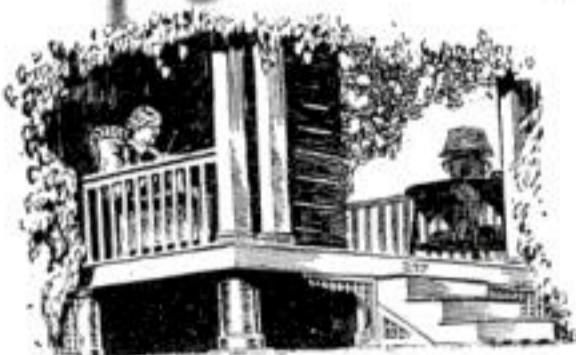
Write today for free book, catalog, free trial offer, sending the Gibson jeweler
The Gibson Mandolin-Guitar Co.,
1522 Parsons Street, Kalamazoo, Mich.

THE HOME WORKSHOP

Drainpipes May Be Used as Porch Supports

THE tile pipes for drains and sewers make strong and attractive porch supports. They are more economical than either stone or brick and are much easier to set up.

The pipe that is 12 in. in diameter is



A tile pipe makes a splendid porch support when used in this fashion

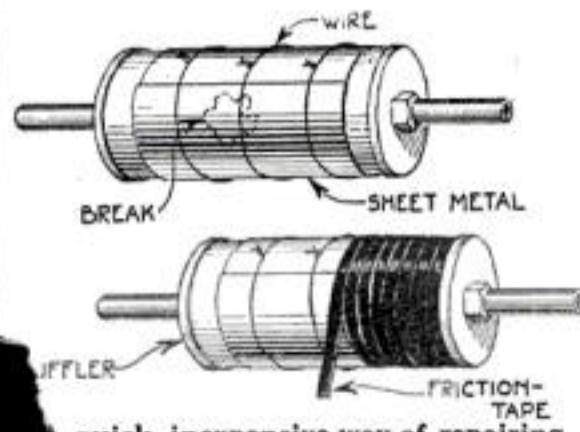
a good size to use. It can be made very much stronger by filling it with concrete. In case the tile should become broken, its concrete core will still support the superstructure.

The tile is set up with the flange end down on a stone or concrete base. By painting the pipes gray they can be made to resemble concrete very closely.

A Quick Repair of a Broken Muffler on a Motorboat

HAVING invited some guests for a ride, of course, the muffler on my motorboat blew out that morning. Not being able to obtain a new muffler that day, and not wishing to disappoint my guests, I proceeded to make a temporary repair.

The hole where it blew out was about 2 in. square and about in the center. A piece of galvanized sheet iron fitted around the muffler served as an outside cover. To hold the sheet iron in place I tied three loops of wire around it and tightened them



by twisting the ends of the wires with a pair of pliers. This gave it sufficient strength, but to prevent leaking, I wound the entire outside covering with friction-tape. On testing with the engine running, the leakage was only a few drops of water a minute. With this repair I ran the boat all day, and it proved very successful.

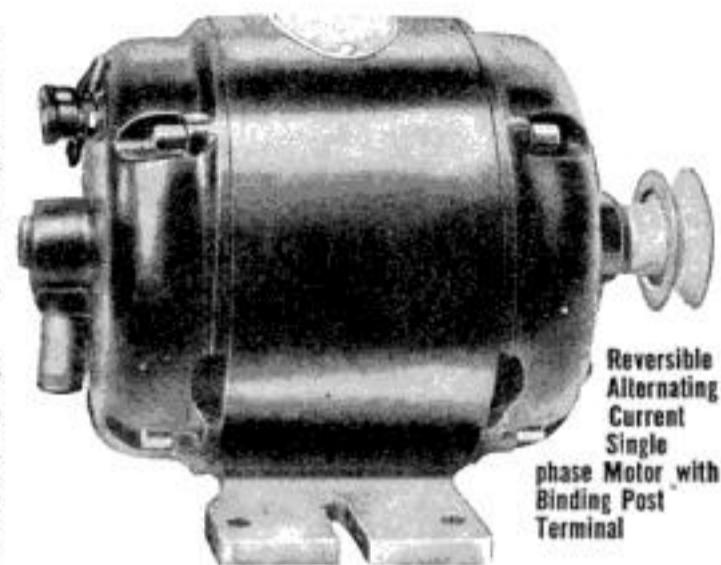
This temporary repair having proved so successful, I decided not to go through the trouble of putting in a new muffler. To insure against leaking, I painted the outside of the tape covering with a thick coat of white lead and when dry I wound another layer of tape over it. Another coat of paint completed the job. I used this outfit the entire season without the slightest trouble or a drop of leakage.—B. Fox.

1/4 H.P. Motors \$11.75 A.C. Factory overstock A.C. Sale, as low as 11=

They're melting away; and after this 10,000 factory overstock lot is sold we'll have to go back to regular prices.

SPECIAL FACTORY OVERSTOCK SALE PRICES

100 lots, each.....	\$11.75
25 lots, each.....	12.00
12 lots, each.....	12.25
6 lots, each.....	12.50
3 lots, each.....	13.00
Single Motors.....	13.50



Reversible
Alternating
Current
Single
phase Motor with
Binding Post
Terminal

A WONDERFUL MOTOR

This motor has just about half as many parts as ordinary motors. Its sturdy simplicity means longer life and less repair and upkeep expense. Has special fan-cooling system and unique starting and cut-out mechanism.

Motor is $\frac{1}{4}$ hp (tested at factory for 50% overload). Single phase, 110 volt, 1740 rpm, 60 cycle split phase induction type; suitable for operating washing machines, churning, cream separators, ventilating fans, lathes, drills, saws, grinders, etc.

One Year Guarantee. We guarantee every motor sold for one year (not six months, the usual custom). Each motor bears a GUARANTEE TAG, entitling the owner to a new motor, express prepaid, should anything go wrong with this motor within the first year of service. Simply return the old motor by express collect in the box in which you receive the new one.

CASH MUST ACCOMPANY ORDER

or, if you prefer, motors will be shipped by express C.O.D. Prices quoted show an actual loss. The sacrifice is made for the sole purpose of converting a factory overstock into cash, for working capital.

Interest your friends, and make us a quantity order, to get the quantity price.

NORTHWESTERN ELECTRIC COMPANY

410-420 SO. HOYNE AVENUE, CHICAGO

MAKE YOUR FORD INTO THIS SPORT CAR Patterns
Life Size Red-i-Kut \$6.40
Other types down to \$2.50 Life size patterns and simple instructions show all details. Materials from hardware store and spare time work complete job at quarter of factory cost. Order NOW from this ad. showing bodies, tops, windshields mailed for 5c postpaid. KUEMPEL CO., 86 KUEMPEL BLDG., CUTTENBERG, IOWA

AGENTS—Auto Free
We need special agents to travel in by Automobile introducing our great line of Nationally-advertised Pure Food Products, Soaps and Household Necessities. Here is an opportunity to earn \$5 to \$12 a day, all or spare time and obtain an Automobile FREE besides. Write at once for full particulars. Address AMERICAN PRODUCTS CO., 5542 American Bldg., Cincinnati, O.

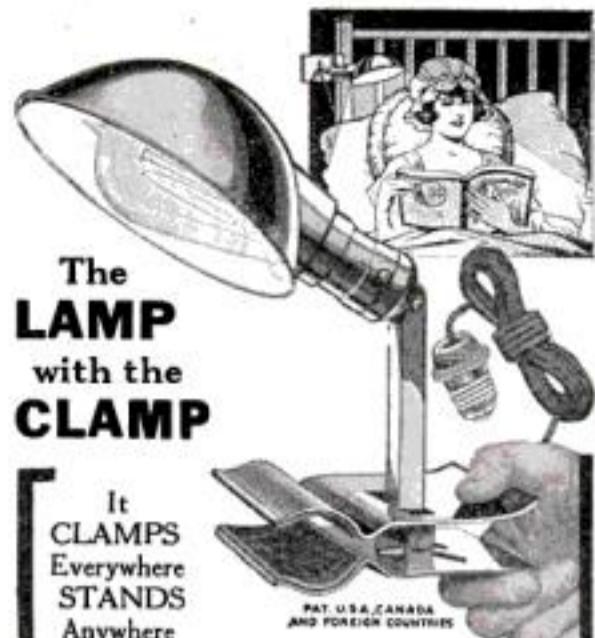


REDUCED PRICES Back to Normalcy—20% Further Reduction SOUTH BEND LATHES—EST. 1906

	Standard Change Gear	Quick Change Gear	Standard Change Gear	Quick Change Gear
9"x3' Lathe	\$176.00	\$216.00	16"x8' Lathe	\$452.00
11"x4' Lathe	228.00	273.00	18"x10' Lathe	656.00
13"x5' Lathe	304.00	354.00	21"x12' Lathe	848.00
15"x6' Lathe	376.00	431.00	24"x14' Lathe	1140.00

Free Catalog No. 67

SOUTH BEND LATHE WORKS, 433 E. Madison St., SOUTH BEND, IND.



Adjusto-Lite

A FARBERWARE PRODUCT

Reg. U. S. Pat. Office

THE lamp of a thousand practical uses. Clamps—stands—hangs—anywhere and everywhere. All the light you need where and when you need it. Prevents eye strain—reduces light bills. No other lighting device like it.

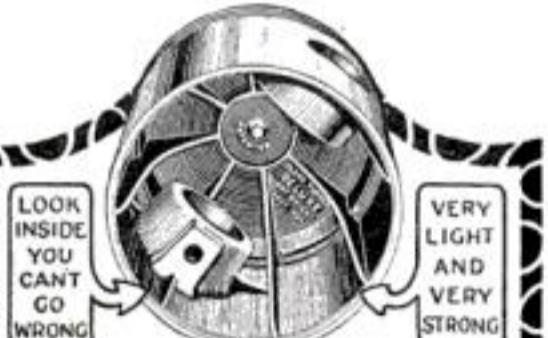
Solid brass; handsome, durable and compact. Clamp is felt-lined—can't scratch. Guaranteed five years. Complete with 8-ft. cord and plug \$5

Get an Adjusto-Lite today. If your dealer doesn't carry it order direct.

S. W. FARBER
141-151 SO. FIFTH ST., BROOKLYN, N. Y.

Prices in U. S. A., complete
with 8-foot cord, plug and
socket. Brush Brass finished,
\$5.00; Statuary Bronze or
Nickel finish \$5.50. West of
Mississippi, prices
25¢ per lamp higher.

TRADE MARK



We claim—and can prove!

that DELUXE light weight cast iron pistons will vastly improve the performance of any motor in which they are installed; that they will actually save oil and gas, eliminate vibration, give quicker "pick-up" and greater power, and lessen wear on bearings, wrist pins and rods, adding to the life of the motor.

DELUXE
LIGHT WEIGHT CAST IRON PISTON
The Successful Light Weight Piston.

Are From 40 to 50% Lighter Than Stock Factory Cast Iron Pistons

Both technical man and layman will appreciate the patented scientific ribbed reinforcing design which has a threefold purpose—reduces weight, strengthens head and skirt, and also dissipates heat because of the enlarged radiating surface, thereby insuring a cool-running motor. They can be fitted close, eliminating leakage and piston slap. DELUXE Pistons are made in all standard sizes and all oversizes for over 1200 makes of internal combustion engines. Write for copy of Dynamometer test made at Ohio State University.

Patented and manufactured by

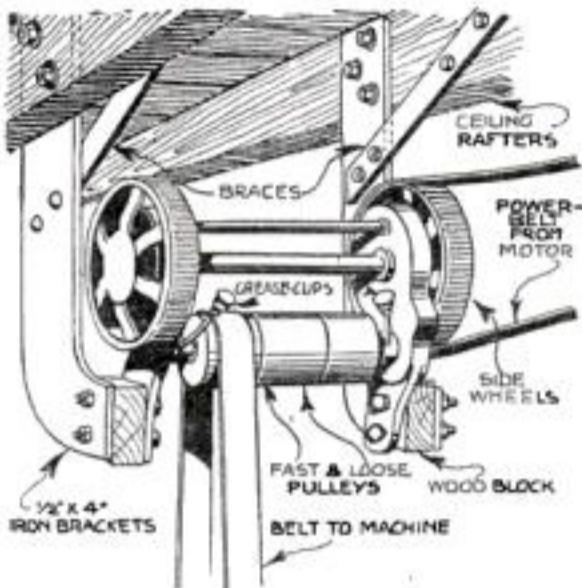
CLARK-TURNER PISTON CO., Inc.
Station C Los Angeles, Calif.
For sale by all good dealers and garage men



THE HOME WORKSHOP

The Old Lawn-Mower Becomes a Good Countershaft

TAKE one old lawn-mower with a 16-in. blade, which would mean 21½ in. over all. Remove the cutting-blades on the shaft and the wooden roller on the side extension castings. Put on the pulleys (iron if desired) and reassemble. Then



Use the old lawn-mower as a counter-shaft in your shop

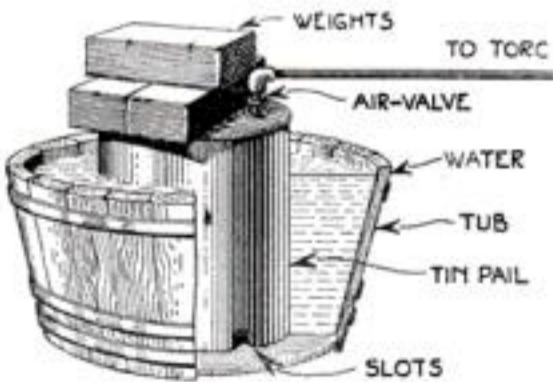
clamp the side braces on. These are bent as shown and braced and blocked.

The power belt runs over one of the 10-in. mower wheels. This drives the shaft at high speed and the speed desired for operating the machine, etc., is obtained by putting on the right size wooden pulleys.

Two grease-cups are tapped in and the countershaft is made at an outlay of a very few cents.—P. P. AVERY.

Pail and Tub as an Improvised Air-Compressor

FOR operating a small blowpipe a steady stream of air may be maintained by means of the improvised arrangement shown in the illustration. The device consists of an inverted pail, preferably a large lard-pail, in a tub of water. A connection for the air-pipe is made by screwing an old



This device will produce a slight air pressure that can be used in connection with the gas flame

tire valve or similar part on to the bottom of the pail. A slot at the rim of the pail permits the water to enter when the pail is inverted in the tub of water and forces the air through the hole. A suitable weight is placed on the pail to hold it in the water.

When the air supply is exhausted, it is simply a matter of raising the pail, which releases the water, and pressing it down into the tub again. This simple air-compressor is used by a local tinsmith in preference to a foot bellows or other pump, probably because of its inexpensive construction and unfailing operation.

Be A Floor Surfacing Contractor

Make \$5,000 to \$15,000 or More Yearly

New, uncrowded field. Architects and general contractors know the American Universal and prefer its work. They prefer to submit the floor surfacing contracts, as it is a big business in itself. We furnish office forms, advertising, etc.—in fact, we practically set a man up in business. Business comes easily.

RESURFACING OLD FLOORS

Every building, large or small, is a prospect. Hundreds of floors right in your own vicinity need resurfacing. The owners will be glad to have you do it when you show them how easily and quickly the work can be done with the American Universal Electric Machine. Old floors made like new—new floors made perfect.

Don't ever get caught out of work again—get into a big paying business of your own. Floor Surfacing Contractors pay for machines first month and make big profit besides. Write today for full information. Say whether you are a building contractor.

THE AMERICAN FLOOR SURFACING MACHINE CO.
Originators of Floor Surfacing Machines
524 South St. Clair St.
Toledo, Ohio, U. S. A.

THE AJAX EYELET FASTENER BINDS PAPERS QUICKLY AND PERMANENTLY

It Saves Time by Punching the Hole, Feeding the Eyelet and Clinching it in One Operation.

Drop the eyelets into the magazine and go right ahead. Order from your stationer or direct.

Write for our catalogue of office tools

MACHINE APPLIANCE CORPORATION

351-353 Jay St. Spec. Dept. Brooklyn, N. Y.

LOOK

50¢

Look

Wonderful Instrument. Greatest thing yet. Nine separate articles in one. Everybody delighted with it. Odd, curious and interesting. Lots of pleasure as well as very useful. It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

JOHNSON SMITH & CO., Dept. 709, 2224 N. Halsted St., CHICAGO

With Illus. at back of book.

3 for \$1.25

It is a double Microscope for examining the wonders of nature. It is also an Opera Glass, a Stereoscope, a Burning Lens, a Reading Glass, a Telescope, a Compass, a Pocket Mirror, and a Laryngoscope—for examining eye, ear, nose and throat. It is worth all the cost to locate even one painful cinder in the eye. Folds flat and fits the pocket. Something great—you need one. Don't miss it! Sent by mail, with 200 page Novelty Catalog, ONLY 50¢ or 3 for \$1.25

This One



32CY-URH-DD28



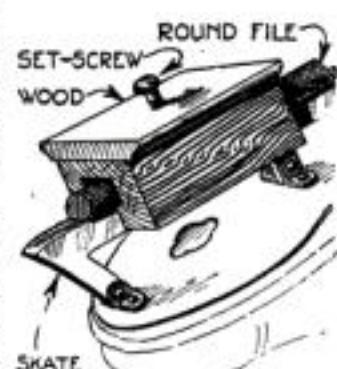
THE HOME WORKSHOP

This Sharpening-Tool will Concave the Ice-Skate

ONE of the best ways to sharpen a skate is to slightly hollow or concave it in the center. The depression runs the long way of the runner and it is difficult to make it accurately unless you have a tool to hold the round file. The picture shows one designed for this purpose and that will do the work well. It is pushed up and down the skate blade lengthwise, the motion being similar to that used by a carpenter planing the edge of a board.

You can make this device in a short time out of scrap material and it will serve you well for years. The wood used should be hard and sound. The top piece is 1 in. thick. The blocks between which the skate-blade fits are $1\frac{1}{2}$ in. thick. They are screwed firmly to the top, or, rather, the top is screwed or bolted to them. The slot is larger where the piece of round file fits.

The file is held securely from slipping either way by a short bolt which comes down through the center of the top piece. The skate may be held in one hand while the tool is used, or it may be placed in a vise. The tool sharpens the skate in just the desired way and the file may be turned around at will or replaced when badly worn.

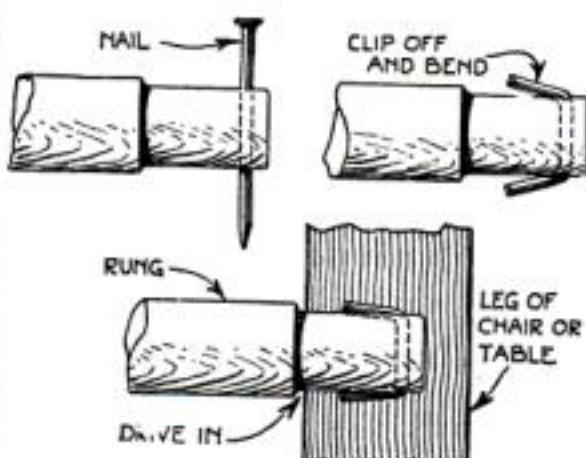


This method of concaving a skate-blade is simple

Furniture-Repair Kink for Holding Rungs and Legs

TO hold rungs or legs in furniture a simple suggestion is offered in the illustration. This prevents the rung from becoming loose, as it invariably does when glued in place without any fastening other than the glue.

The fastener is simply a wire nail driven through the leg or rung. After being



A good method of mending a chair runner or a broken chair leg

clipped off at each end with a pair of wire cutters, it is bent back enough to slant slightly upward at the ends. The glue is then applied and the rung or leg driven in flush. The ends of the nail are springy enough to open up slightly and catch in the wood. This method does not disfigure the wood as do nails or screws driven in from the outside. Cut the nail ends short enough to come inside the hole with the rung driven entirely in.—G. A. LUERS.

Prices Reduced!

One Man Moves It.

310 Cuts a Minute.

More in Use Than All Others.

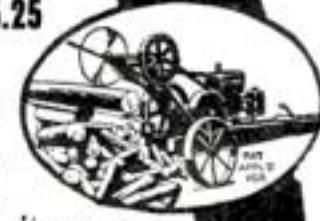
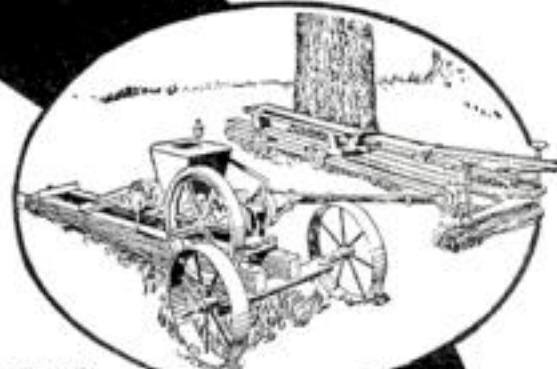
One Man Log Saw

30 Days' Trial.

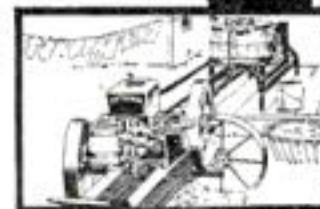
The Standard of the World.

**NOW ONLY
\$127⁵⁰**

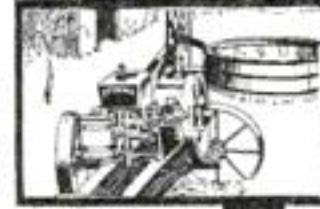
The OTTAWA Tree Fallers attached to Log Saw in a few minutes. Quick change back to Log Saw. When sold with Log Saw, only \$35.25



Branch Saw. Sold alone or with Log Saw.



The OTTAWA runs your washing machine and does other belt work.



Use it year 'round as portable power plant. Pumps water, grinds feed, etc.



Mail Coupon Today

OTTAWA
4 H.P. Motor
Fastest - Cutting **LOG SAW**

Saws logs into any lengths—faster, easier, cheaper; cuts down trees; buzzes up limbs, poles and branches. When not sawing, use as portable engine for grinding, pumping, shop work, etc.

Friction Clutch, lever controlled starts and stops the saw while engine runs. Power Force Feed makes the OTTAWA saw the human way—safest, easiest, best way. **Magneto Equipped**, at no extra charge. No "extras" to buy. Fastest cutting—310 cuts a minute!

Immediate Shipments from factory at Ottawa, Kansas, or nearest to you of these Factory Branches: Pittsburgh, Pa.; Indianapolis, Ind.; Atlanta, Ga.; Albany, N. Y.; St. Paul, Minn.; Dallas, Texas; Pueblo, Colo.; Portland, Ore.; San Francisco, Calif., 30 Days' Trial; 10-Year Guarantee.

From Far-Off New Zealand!

"Just received my OTTAWA Log Saw. Mighty glad to have it. I put some fuel in the tank, gave her a turn—and she went off like a grasshopper. I am well pleased with the outfit. It is very compact, runs well and cuts fast."—SAMUEL T. MILLER, Upper Plain, Masterton, New Zealand.

FREE! Get my Money-Saving Offer, Lower Prices and my fine Free Book on the OTTAWA. I open your eyes to real money-making opportunities. Send today. Use Coupon Now.

H. C. OVERMAN, Gen'l Mgr.

OTTAWA MFG. CO.

1807-D Wood St., OTTAWA, KANSAS

H. C. Overman, Gen'l Mgr.,
OTTAWA MFG. CO.,
1807-D Wood St., Ottawa, Kansas.
Without obligation to me please send me your Free Book and New Lower Prices and Special Offer on the OTTAWA Log Saw.

Name _____
Address _____

Big Money for the Man Who Knows What to Do!!

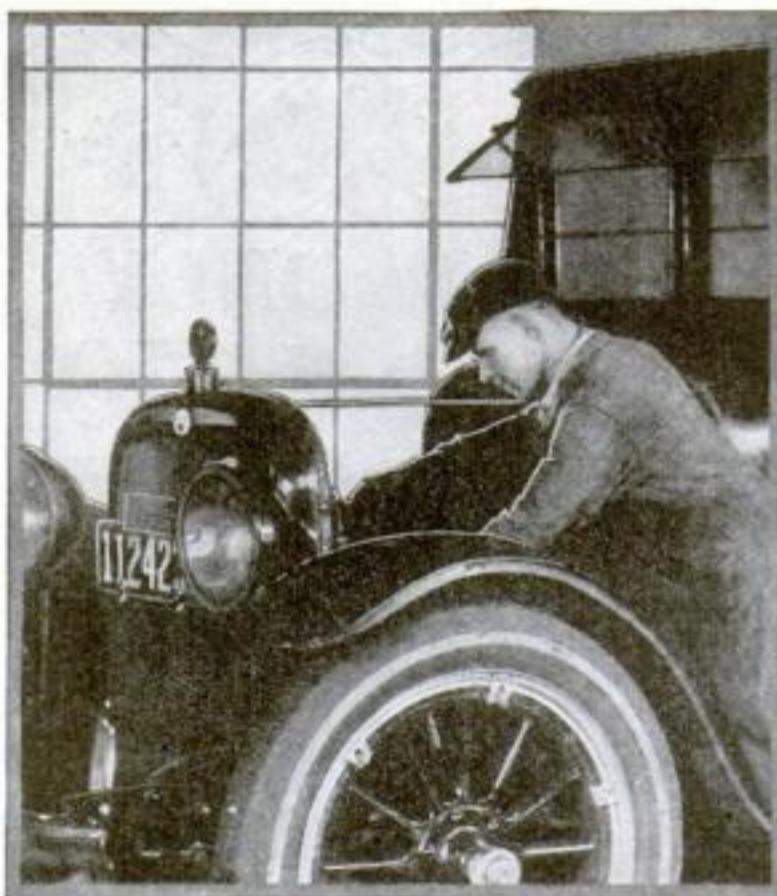
Big Opportunities in Auto Game

Right now men like you are wanted for big pay jobs in the Automobile Engineering field. Over 8 million cars are in operation and there are more jobs open than there are good men to fill them. Thousands of men are needed to keep these 8 million cars in going condition.

The percentage of new cars this year is smaller than for several years past. This means more work on the old cars—rebuilding and replacing parts.

Learn at Home—Easy, Inexpensive

You don't have to serve an apprenticeship. You don't have to go to school and spend hundreds of dollars for tuition and board. The new Library of Automobile Engineering will tell you everything you need to know. It explains everything about every standard make of car. All the brand new models are included as well as the cars made for several years back. Thousands of pictures show you how everything is done.



**New
AUTO BOOKS
Shipped FREE
Mail
Coupon**



15 Auto Experts Will Help You

This library is the work of 15 leading automotive experts who each put a lifetime of experience into it. They know exactly what you need and give it to you in plain everyday English. It cost over \$50,000 to produce these books yet they are sent to you without a deposit of any kind for 7 days' free examination.

Membership FREE

With each set of Automobile Engineering Books we give a one-year membership in this Society worth \$12.00. This membership entitles you to the following benefits:

Consulting Privileges: The Society maintains a staff of Engineers and Experts to work out problems and answer questions by mail for its members.

Standard Tests: The means by which you are able to determine your exact fitness for the work you are doing or would like to do. This means finding out how much you really know about your job.

Free Employment Service: All members can use the Society's free employment service to get a better job. This includes listing in the bulletin called "Men."

Everything About Every Auto

The 6 big volumes flexibly and durably bound contain 2700 pages and more than 2400 pictures, blueprints and wiring diagrams showing the inner workings of every car. A complete index enables you to find the very thing you want in a second or two. No need to go through the whole set or even a whole book to find it. In this way you can devote more time to the most important things but you are saved needless study on the things you won't have much use for. The information is right on the job though, to help you whenever you need help.

A Few of the Subjects Covered

Gasoline Motors (Construction and Repair)—Automobiles (General description of all makes)—Engines—Pistons—Accessories—Crankshafts—Crank Cases—Carburetors—Manifolds—Fuel Supply—Valves—Exhaust Systems—Lubrication—Bearings—Flywheels—Clutches—Transmissions—Gears—Steering Mechanisms—Axles—Chassis—Springs—Final Drive—Brakes—Wheels—Tires—Radiators and Cooling Systems—Rims—Electrical Equipment—Generators—Motors—Ignition—Starters—Lighting Systems—Storage Batteries—Magneto—Welding—Bench Work—Machines—Garage Equipment—Trouble Shooting—Motorcycles—Steam Automobiles—Gasoline Tractors—Trucks—Electric Automobiles—Fords.

Don't Send Money Now

We will lend you the whole set of these great pay-raising books for a week to use as you please in your shop or home. Examine them carefully and decide with the books before you if you want to take advantage of this golden opportunity. Over 75,000 sets have been sold on this no-money-down plan—keep the books a week and send them back at our expense or pay \$3.00 a month until the special price of \$24.80 has been paid. (Regular price is \$45.00.) There are no strings to this offer. It is open to every man over 21 years in the United States and Canada. You sign nothing but this coupon. No agent will call upon you. Mail the coupon and get the books, then decide whether or not you want to keep them. Mail the coupon now.

**American Technical Society
Dept. A-209 CHICAGO**

**American Technical Society,
Dept. A-209, Chicago**

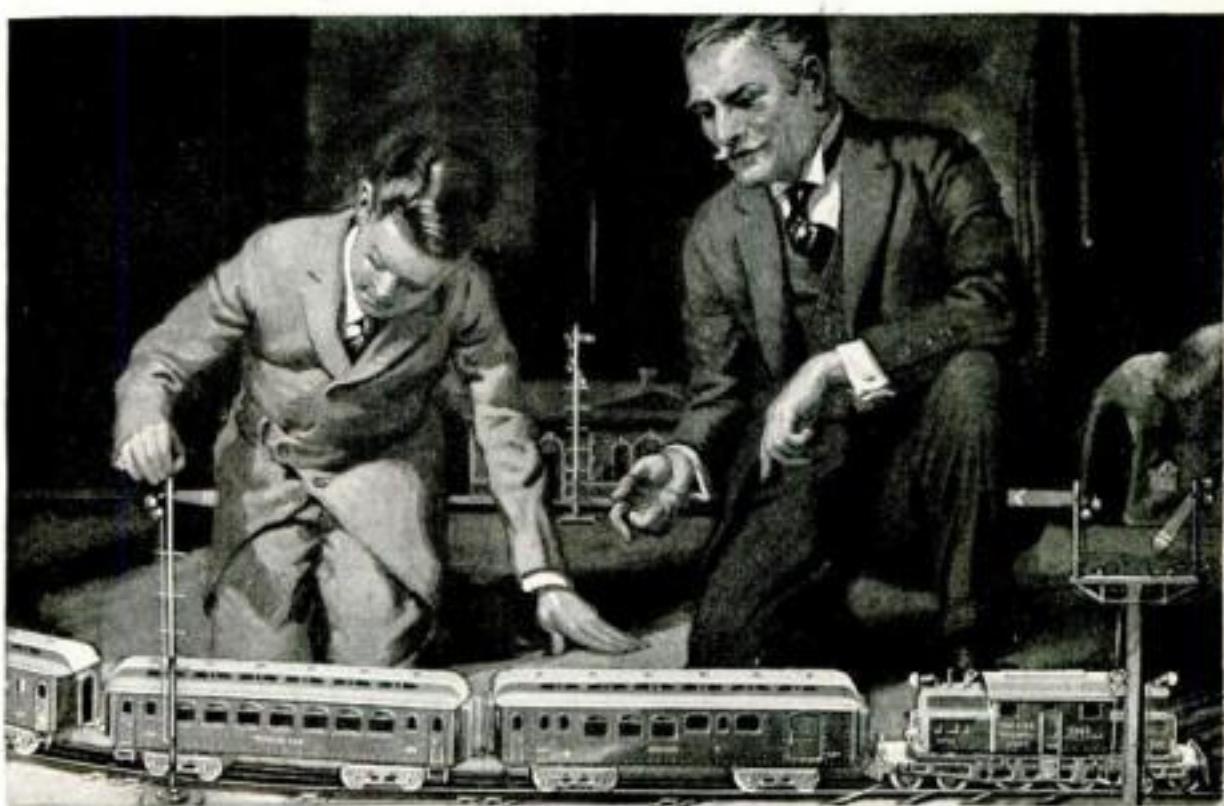
Send me the 6 volume set of Automobile Engineering books for a week's free trial by express collect. I will either return the books in one week at your expense or send you \$2.80 as first payment and \$3.00 every month until a total of \$24.80 is paid. With these books I am to receive a free membership in your Society, including Consulting Privileges, Standard Tests and FREE Employment Service.

Name.....

Address.....

City..... State.....

Reference



Every boy loves boats and trains

LOCOMOTIVES and ships fascinate a boy. Playing with toy trains and boats is the best fun in the world. They never seem to lose their appeal.

Ives trains are wonderful reproductions of originals. There are both steam and electric type locomotives, propelled by springs or electricity, cars of all kinds—passenger, freight, coal, oil, lumber, livestock; with switches, bridges, tunnels, stations signals, station lights and crossing gates.

Ives boats are made of steel, beautifully painted, with long-running spring mechanisms, propellers and rudders.

They are complete even in small details. Real ships were used for models—ocean liners, diving submarines, destroyers, tug boats, motor boats, U. S. Merchant Marine steamships.

Ives Trains and Ives Boats are sturdy American-made toys that every boy would like to own. They are perfect Christmas gifts.

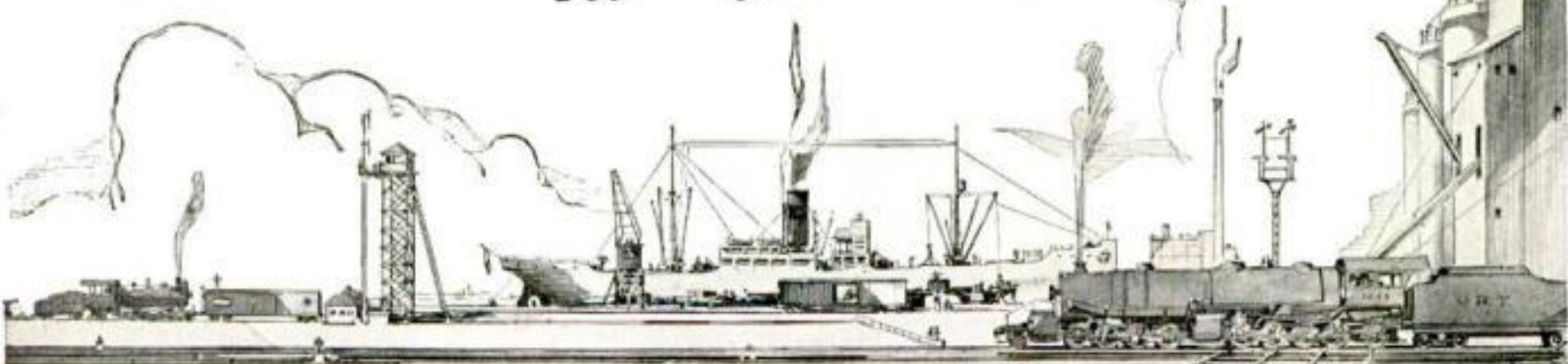
*Send 10c. for Booklet
of Trains and Boats.*

THE IVES MANUFACTURING CORPORATION, 191 Holland Ave., Bridgeport, Conn.



Ives Toys

Make Happy-Boys





The Victrola is the gift of all music to your home

Wherever the dawn of Christmas morning finds a Victrola, there are gathered the greatest artists of this generation. All have contributed their art to the Victrola, positive that it is the one instrument which brings to you their authoritative interpretations in the tones of actual reality.

Will there be a Victrola in your home this Christmas? \$25 to \$1500.

Victor Talking Machine Company, Camden, N.J.



"HIS MASTER'S VOICE"

This trademark and the trademarked word "Victrola" identify all our products. Look under the cat! Look on the label!

VICTOR TALKING MACHINE CO., Camden, N.J.